Strategic Environmental Assessment of Estonian Marine Strategy`s Programme of Measures to achieve and maintain Good Environmental Status of Estonian marine area

Draft report (12.10.2015)

Client: **OÜ Eesti Keskkonnauuringute Keskus**

Prepared by: **Tallinna Tehnikaülikooli Meresüsteemide Instituut (Marine Systems Institute at Tallinn University of Technology)**
OÜ Alkranel

Head of SEA working group: **Alar Noorvee**

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INTRODUCTION

The subject of this strategic environmental assessment (hereinafter SEA) is the Estonian Marine Strategy`s programme of measures to achieve and maintain good environmental status of the Estonian marine area. Specifically, the subject of this SEA is to conduct a strategic environmental assessment of the new measures that have been developed during the preparation of the Estonian Marine Strategy`s draft programme of measures. The programme of measures to achieve and maintain good environmental status of the Estonian marine area was initiated by the Decree No. 342 of 8 April 2015 of the Minister of the Environment.

The purpose of preparing the programme of measures is to identify measures which need to be taken to achieve or maintain good environmental status of the Estonian marine area and to reach the set environmental targets. The cost-effectiveness and technical feasibility of the measures have to be ensured, and prior to adoption of every new measure, impact assessments, including cost-benefit analyses, have to be conducted. When preparing the programme of measures, the impact of the measures on the waters outside the respective marine area has to be taken into account to minimise damage to and, if possible, amplify the positive effect to the relevant marine waters.

The objective of the SEA is to explain, describe and assess the possible material strategic environmental impact caused by the implementation of the new measures planned in the programme of measures and present measures that alleviate and/or prevent the negative environmental impact or strengthen the positive impact. Another objective is to assess the internal concordance of the measures developed in the programme of measures and their interlinkage with national and international environmental objectives. The SEA is conducted in accordance with the *Environmental Impact Assessment and Environmental Management System Act* (in effect until 30 June 2015 (the transitional provision applies until 1 July 2018).

The Ministry of the Environment is the authority that initiates the preparation of the programme of measures and adopts it. The programme of measures is prepared by Stockholm Environment Institute Tallinn Center (Säästva Eesti Instituut), Estonian Marine Institute of Tartu University (Tartu Ülikooli Eesti Mereinstituut) and Marine Systems Institute at Tallinn University of Technology (Tallinna Tehnikaülikooli Meresüsteemide Instituut). The organisation responsible for organising preparation of the SEA is Eesti Keskkonnauuringute Keskus OÜ and the organisations that prepare the SEA are Alkranel OÜ and Marine Systems Institute at Tallinn University of Technology.

The members of the SEA working group:

- Alar Noorvee, SEA lead expert of OÜ Alkranel;
- Taavi Liblik, senior researcher of Marine Systems Institute at Tallinn University of Technology;
- Natalja Kolesova, junior researcher of Marine Systems Institute at Tallinn University of Technology;
- Elar Põldvere, environmental specialist of OÜ Alkranel;
- Tanel Esperk, environmental specialist of OÜ Alkranel;
- Reet Needo, environmental specialist of OÜ Alkranel;
- Veljo Kabin, environmental specialist of OÜ Alkranel;

- Kai Künnis-Beres, researcher of Marine Systems Institute at Tallinn University of Technology.

The public display of the draft SEA programme took place between 13.07–27.07.2015 and the public discussion was held on 27 July 2015. The SEA programme was approved by letter No. 11-2/15/5029-14 of 12 October 2015 of the Ministry of the Environment (Annex 2).

1. PROGRAMME OF MEASURES AND ITS LIST OF NEW MEASURES

According to Article 13 of the Marine Strategy Framework Directive (MSFD), the Member States shall identify the measures which need to be taken in order to achieve or maintain good environmental status. Article 5 states that the Member States shall develop a programme of measures by 2015 at the latest and the programme has to enter into operation by 2016 at the latest.

The programme of measures consolidates all necessary activities that are needed to fulfil various environmental protection obligations that derive from Estonian legislation and international regulations to achieve good marine environmental status and control the pressures that influence it. An important part of the marine programme of measures are measures that are implemented in order to achieve good status of coastal waters that meet the requirements of the Water Framework Directive (WFD) and the condition that has been stipulated by other EU directives (Nature Directive, Birds Directive, Urban Waste-Water Treatment Directive, Nitrates Directive etc.). The Marine Strategy does not copy the programme of measures but refers to the measures in the mentioned directive. If additional new measures are necessary to achieve good status of the marine environment, such measures shall be described in the Marine Strategy`s programme of measures.

The new measures included in the Marine Strategy`s programme of measures are necessary because the current measures are implemented under various regulations that do not allow achieving the targets of good environmental status of the marine area (http://www.envir.ee/sites/default/files/hks_ks_aruanne.pdf).

Below is presented the list of new measures compiled by the expert group that prepares the programme of measures (version of 15 September 2015. The list is described in more detail in Annex 3 of the Strategic Environmental Assessment report.

Biological diversity (D1)
1. Establishing a marine protected areas network in Estonia`s economic zone.
2. Adoption and implementation of the ringed seal protection plan.
3. Developing regional aquaculture programmes to control a potential environmental pressure.

Non-indigenous species (D2)
4. Awareness building about non-indigenous species to control their invasion.
5. Ratification of the Ballast Water Management Convention (BWMC) and facilitating its implementation by involvement in the planned regional information system and implementation thereof.

Fisheries (D3)
6. Development of regional fishing restrictions and updating commercial fish size limits.
7. Facilitation of realisation of low valued fish.
8. Adjusting catching capacity to meet the conditions of good environmental status.

Eutrophication (D5)
9. Facilitation of introduction liquefied natural gas (LNG) as ship fuel.
10. Reduction of dumping of untreated wastewater from ships directly into marine waters, including ensuring capacity of wastewater intake from cruise ships in ports.

11. Additional nutrient, hazardous substance and litter inflow reductions from stormwater directly to the sea – the construction of stormwater sewerage and treatment systems.

Alteration of hydrology conditions (D7)
12. Establishment of restrictions on vessel traffic in case of impact caused by waves.

Contaminants in water (D8)
13. Improving the capacity of marine pollution control to respond to environmental emergencies at sea.
14. Control of environmental risks accompanying bunkering operations at sea.

Marine litter (D10)
15. Improving the marking system of fishing gear in order to better control fishing and prevent abandonment of fishing gear.
16. Preparing an action plan to improve control over fishing gear and clean the sea of abandoned fishing gear.
17. Prevention of marine litter and organisation of environmental educational events that improve awareness and cleaning sprees.
18. Reducing the use of plastic bags, supporting relevant publicity and educational activities.
19. Preparing and implementing action plans of local authorities in coastal regions to prevent and reduce marine litter.
20. Organisation of a common marine litter reception system in ports.

Underwater noise and energy (D11)
21. Establishing an impulsive sound register.

2. OVERVIEW OF THE CURRENT SITUATION, PROBLEMS AND PRESSURES

2.1 Overview of the natural environment

A report about the status of marine areas under the jurisdiction of Estonia was prepared in 2012 (TÜ Eesti Mereinstituut, 2012). This section (2.1) has been prepared based on this report and supplemented with information from other sources, if necessary.

2.1.1 Bathymetry, characteristics of seafloor and coast

The Estonian marine area consists of three Baltic Sea subareas – the Gulf of Finland, the Gulf of Riga and high seas part of the Baltic Sea, where the characteristics of coasts as well as bathymetry significantly varies (Figure 2.1). In the south-eastern part of the Gulf of Finland (Narva Bay) the coastline is not varied and the sea depth is mainly between 20–40 metres. In the western part of the Gulf of Finland, the coastline is varied. There are many islands in the region. The sea is relatively deep, the seafloor topography is characterised by shallower and deeper areas (over 100 m deep). The open sea part of the western islands has a varied coastline (bordering with the western Estonia islands) and in the coastal sea mainly 10–40 m deep, although deepest in the Estonian marine area in the territorial sea and economic zone outside it. The coastline of the Gulf of Riga is varied in north and not varied in east. Although the gulf is for the most part shallower than 30 m, the sea is deeper than 50 m in the central part of the gulf. The Pärnu Bay is a comparatively small and shallow (below 10 m) part of the Estonian coastal sea. Estonian continental area and the larger islands of Estonia (Saaremaa, Hiiumaa, Muhu and Vormsi) are surrounded by Väinameri with the average depth of only 5 m.

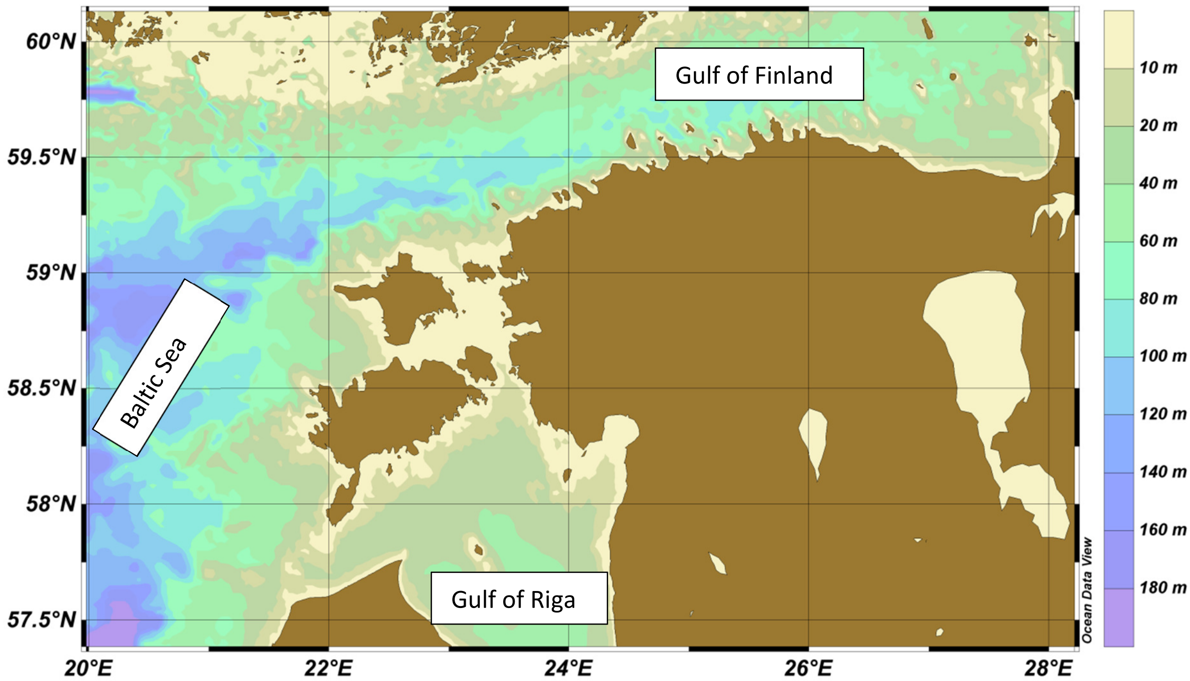

Figure 2.1. Bathymetry of the Estonian marine area (Läänemere Uuringute Instituut, based on depth data of Warnemünde (IOW) (Seifert *et al*., 2001); Ocean Data View software used (Shlitzer, 2010).

The Estonian coast is very diverse. According to Kaarel Orviku (1993) classification, there are eight types of coasts in the Estonian coastal sea: cliff shore, scarp shore, rocky shore, till shore, gravel shore, sandy shore, silty shore, artificial shore (artificial facilities – breakwalls, quays and protective walls). It is important to ensure that anthropogenic processes do not influence significantly the proportion of various coastal types in the Estonian coastal sea.

Coasts in the Estonian coastal sea are in very different stages of development. There are coastal zones that have active, maturing and matured or dead coasts (Orviku, 1993). The fast-developing coasts are usually exposed to waves and active coastal processes occur there constantly. On maturing coasts, changes occur only during high water stages and strong storms. In dead coastal zones, waves do not cause usually any changes any more. Construction of hydrotechnical structures usually poses a problem in areas with active coastal processes.

When compiling maps that cover the entire Baltic Sea, e.g. during the EMODnet geological pilot project (Figure 2.2) and Interreg project BALANCE, mainly existing archive data from earlier studies have been used to characterise the seafloor of the Estonian marine area. Based on the analysis conducted during the EMODnet project and the used classification, mostly muddy sediments are characteristic of the Estonian marine area. Moraine, sand and coarse-grained sediments can also be found (shingles). Bedrock or mixed sediment areas are less frequent.

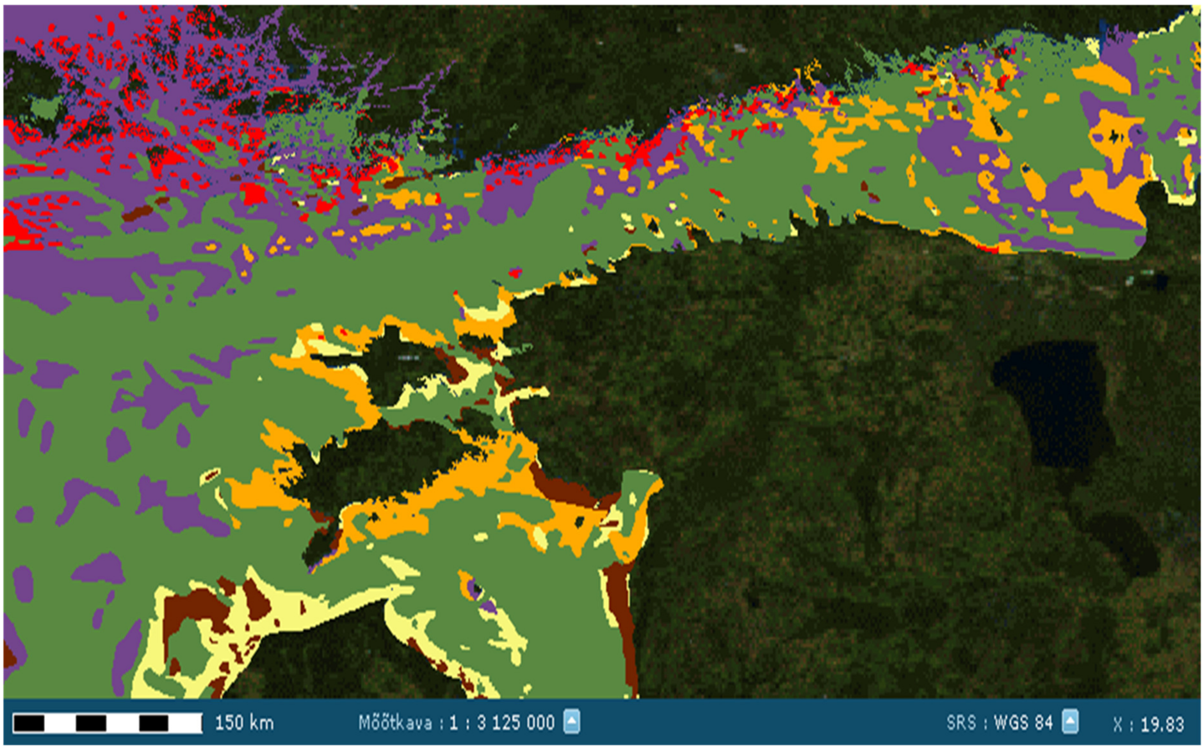

Figure 2.2. Seabed substrate of the Estonian marine and neighbouring areas based on the data of EMODnet pilot project (source: http://onegeology-europe.brgm.fr/geoportal/viewer.jsp; archive data has been used for the Estonian marine area). Categories: green – mud to sandy mud; light yellow – sand to muddy sand; brown – coarse-grained sediment; lilac – mixed sediment; dark yellow – till; red – bedrock. The map was published by the Estonian Marine Institute of Tartu University (TÜ Eesti Mereinstituut 2012).

Most frequent seafloor reliefs in the Estonian marine area outside coastal sea are muddy or clayey plains and valleys. In the western part of the Gulf of Finland and in the northern part of the high seas part of the Baltic Sea are plains with hard seafloor. In the shallower part of the Gulf of Riga, Väinameri and offshore bordering Hiiumaa and Saaremaa, are plains with coarse gravel. Coarse gravel, sandy and clayey plains alternate in the shallower part of the Gulf of Finland.

2.1.2 Temperature, salinity, stratification, ice cover

Temperature and salinity define mostly the characteristics of a region`s ecosystem, including species composition. The temperature and salinity fields in the Baltic Sea are highly variable both in time and space, which is caused by complex topography, strong horizontal and vertical gradients and major atmospheric variability at different temporal scales, i.e. long-term trends, year-on-year changes, seasonal cycle and synoptic variability. It is possible to determine the proportion of fresh water that originates from mainland based on seawater salinity which in turn determines the natural content of nutrients. Salinity is also one of the factors that regulates the species composition of the marine biota and limits the use of particular species as indicators of the environmental condition. There are strong horizontal and vertical salinity gradients in the Estonian coastal sea. The coastal sea with salinity lower than 5.0 g/kg of the medium surface layer covers an area from the mouth of River Narva to the area near the mouth of River Purtse and the Pärnu Bay.

Usually there is a three layer (in summer) and a two layer (winter) temperature and salinity vertical structure in sufficiently deep (> 60–80 m) parts of the sea. Seasonal mixed warm and less salty upper layer is usually 10–30 m thick. Under the upper mixed layer, there is a seasonal temperature and salinity jump that separates the upper layer from the colder medium layer that forms in winter. There is a salinity jump at 60−100 m under the medium layer and, below that, a warmer (5–6 °C) and saltier water originating from the North Sea that on its way from the Danish straits to the Estonian marine areas has mixed with the water of the medium layer.

Several sources (e.g. Mackenzie and Schiedek, 2012) have pointed out a significant rise in the temperature of the surface layer in the Baltic Sea during the past century. It has been found that in later years (1990–2008) the warming of Estonian coastal sea has been especially rapid, around 0.6−1 °C decade (Lehmann *et al.* 2011). For the same period (end of the 1980s and start of this century), it has been found that the bottom layer of the Gulf of Finland has become warmer and saltier (Liblik and Lips, 2011). The variability of synoptic temporal scales depends on advection, mesoscale processes and intensity of vertical mixing. The largest synoptic scale changes in salinity of the upper layer are accompanied by advection and mesoscale processes. Upwelling events are frequently the cause of local high salinity levels of the surface layer in the Gulf of Finland and offshore Baltic Sea. Cold water transported to the upper layer during upwelling is usually saltier. However, winds that hinder estuarial circulation (from west) and stimulate it (from east) play also a role in influencing the upper layer. In the first case saltier water is transported from the open sea part of the Baltic Sea and in the second case less salty water from the eastern part of the gulf to the surface layer of the Gulf of Finland.

Density and stratification of seawater depend mainly on the variability of temperature and salinity described above. If we study the hypsographic curve of the Estonian marine areas, it shows that around 20% of the Estonian marine area is so shallow that it should be mixed from the surface to the bottom most of time, 50% is temporarily stratified and around 30% of the marine area is deeper than 60 m that allows formation of the halocline, i.e. there is a high probability that in this area the water column is stratified all year around. Hence, Väinameri and the Pärnu Bay are constantly mixed marine areas, the Gulf of Riga and the south-eastern part of the Gulf of Finland are temporarily stratified and the water column in the western part of the Gulf of Finland and offshore Baltic Sea is constantly stratified for the most part. The most significant change in the stratification patterns that have occurred in recent decades is in the bottom layer where water has been much denser after the middle of the 1990s. As the temperature of the surface layer has increased in recent years, changes can be expected in the upper pycnocline stratification. Upwellings weaken stratification as does hindering of estuarial circulation. Stimulating estuarial circulation in the Gulf of Finland increases stratification. In the Gulf of Riga stratification depends mostly on the temperature and spread of the less salty surface layer because the waters of the deep layer of the Baltic Sea do not reach this area due to relatively shallow Irbe strait. Vertical mixing generated by wind that does not allow stratification to last long plays an important role in shallower marine areas.

Ice cover on the Baltic Sea may be very different every year. In shallow and half-closed bays, ice may cause hypoxia. Abundance of ice is mainly dependent on winter harshness that in turn depends on the atmospheric circulation. If the airflow from the west that carries warmer and more humid air from the North Atlantic is stronger, the winter is softer. In addition, local ice conditions depend on other variables, such as the wind regime or amount of precipitation. Lighter ice conditions in the Estonian marine area exist in offshore Baltic Sea and more difficult ice conditions in Väinameri, the Pärnu Bay and the Narva Bay. Monitoring results of the past hundred years show that the annual maximum ice cover and the ice cover duration on the Baltic Sea has decreased (The BACC II Author Team, 2015).

Ice is an important factor that influences vessel traffic, processes that occur in ports and on the coast. Difficult ice conditions increase the frequency of shipping accidents. Thick ice cover and/or ice pressure caused by a strong wind may leave ships icebound. It is also speculated that the recent changes in the ice climate of the Baltic Sea may be partly caused by the increased intensity of marine transport (The BACC II Author Team, 2015).

2.1.3 Currents, wave regime and sea level

Characteristic current velocity in the surface layer of the Estonian marine area is 10–20 cm s^{-1}. At the same time, currents are very changeable and depend largely on local wind. Volatility is dominated by an inert period, a period related to self-oscillation of the Baltic Sea and mesoscale processes (synoptic scale). The maximum current velocities that exceed 1 m s^{-1} have been registered in straits (e.g. Suur väin strait) and along the coast (e.g. in the Gulf of Finland) in case of strong jet currents that occur from time to time. As during summer months the marine area is vertically stratified, the vertical distribution of currents is also characterised by stratification. It is important to note that in the deeper layers of the sea (including close to the seafloor) there may be currents with velocity of 40–50 cm s^{-1}. For example, the Marine Systems Institute at Tallinn University of Technology has measured the maximum current velocity of the demersal layer to be 43 cm s^{-1} in the Gulf of Finland in 2010–2011.

The Gulf of Finland is directly connected to offshore Baltic Sea. There are no straits and thresholds that would restrict the movement of under-halocline water to the Gulf of Finland. In the surface layer of the Gulf of Finland, water motion is on an average cyclonic. As characteristic of stratified estuaries, inflow from offshore Baltic Sea to the gulf dominates in demersal layers (deeper water layers) and outflow from the gulf in upper water layers. Strong south-western winds can temporarily reverse this circulation scheme, i.e. outflow dominates in deeper layers and inflow prevails in the upper layer. In recent years, the structure of simulated currents in the Gulf of Finland for different periods has been analysed with various numerical models (e.g. Andrejev *et al*., 2004). It has been shown that in case of various dominant meteorological conditions, the usual outflow in the surface layer of the northern part the gulf may be more intensive or weaker, but there exist quite stable anticyclonic circulation loops in the southern part of the gulf where the current close to the coast flows also from east to west (Lagemaa, 2012).

The central circulation of the Gulf of Riga is also cyclonic, as in other Baltic Sea basins. Significant differences between the Gulf of Riga and offshore Baltic Sea and open sea part of the Gulf of Finland is that the Gulf of Riga is separated from the open sea by thresholds in straits and exchange of water occurs through quite narrow straits (Irbe strait (Kura kurk) and Suur väin strait) and the gulf mixes to the bottom during autumn-winter storms.

Among the hydrographic conditions/processes that significantly influence the condition of the partly closed seas, including the Estonian marine area, is upwelling. As a result of modelling, it has been suggested that the most intensive region in terms of upwelling is the western part of the Finnish coastal sea in the Gulf of Finland (Myrberg *et al*., 2003). Based on the analysis of distant monitoring data collected in 2000–2006 and meteorological data, it has been concluded that every year from May to September on an average six upwelling events occur in the Gulf of Finland (Uiboupin & Laanemets, 2009), whereas in extreme cases up to 38% of the surface layer of the Gulf of Finland may be covered by upwelling water.

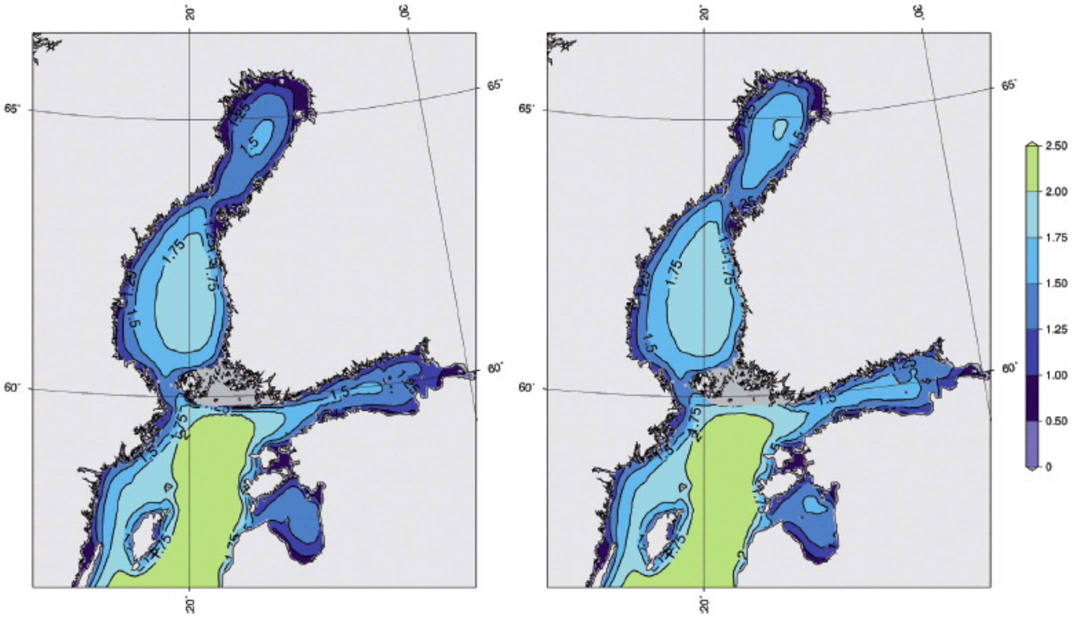

Figure 2.3. Estimated average significant wave height values in the Baltic Sea during 2001–2007 (Tuomi *et al*., 2011).

We describe the wave climate of the Baltic Sea based on the study carried out by L. Tuomi and her colleagues (Tuomi *et al*. 2011). The significant wave height (for the period of 2001–2007) has been over 2 m in offshore Baltic Sea (in the Estonian marine area), over 1.5 m in the open sea part of the Gulf of Finland and 1.0–1.5 m in the open sea part of the Gulf of Riga (Figure 2.3). The average wave height in the coastal sea is significantly lower. A significant wave height that occurred 1% of time exceeded 4 m in offshore Baltic Sea, 3 m in the Gulf of Finland and

2.5 m in the Gulf of Riga. A significant wave height that occurred 0.1% of time exceeded 6 m in offshore Baltic Sea, 4 m in the Gulf of Finland and 3.0–3.5 m in the Gulf of Riga. The maximum registered wave heights in the Gulf of Finland and offshore Baltic Sea are 8.2 m (the northern part of offshore Baltic Sea) and 5.2 m (Helsinki buoy), respectively. Model calculations gave the maximum significant wave height in offshore Baltic Sea 9.7 m for the 2005 January storm (Tuomi *et al*., 2011).

The long-term change of water level in the Estonian coastal sea is primarily related to the slow land uplift in the region and the long-term change in the world sea water level. The analysis of the existing data series show that the water level changes differently in different areas of the coastal sea. The reason is mostly varying land uplift. The largest relative water level (water level in relation to the coast/sea bottom) rise during the past fifty to hundred years has occurred in the coastal stations of Narva-Jõesuu and Pärnu (0.6–1.7 mm/y). In Ristna, the relative water level has lowered 0.9 mm/y since 1950 (Suursaar & Kullas, 2009).

Due to the seasonal nature of winds in the Baltic Sea region, the high water levels are more frequent in autumn and winter. The highest levels of water of recent decades were measured at the Estonian coastal stations during the 2005 January storm when the water level in Pärnu reached over 275 cm and in other places along the Estonian coast 1.5–2 m over Kronstadt gauge (Suursaar *et al*., 2006). The list of flood risk areas includes several coastal areas: Audru rural municipality, Haapsalu town, Hanila rural municipality, Virtsu small town, Häädemeeste rural municipality, Häädemeeste small town, Kuressaare town, Kärdla town, Kaarma rural municipality, Nasva small town, Pärnu town, Tahkuranna rural municipality, Võiste small town and Tallinn city (Keskkonnaministeerium, 2012).

An important aspect in terms of ship connection with mainland is low levels of water. This topic is especially important on Rohuküla-Sviby and Rohuküla-Heltermaa waterways.

Among 48 different bays, water residence time has been estimated to be longest in the Haapsalu Bay and the Matsalu Bay with 10–25 and 6–15 days, respectively. Water residence time in the Pärnu Bay is also relatively long, from 5 to 13 days. In other larger bays, water residence time is clearly shorter than a week (TÜ Eesti Mereinstituut, 2012).

2.1.4 Nutrients and oxygen

Nutrients, such as nitrogen and phosphorus, are necessary for the production of phytoplankton, macrophytes and bacteria in the sea. Because almost all inorganic nutrients have been used up in the surface layer during the vegetation period, dissolved inorganic nitrogen (DIN) and dissolved inorganic phosphorus (DIP) are usually measured in winter when biological activity is the lowest within the framework of the marine environment monitoring programme (HELCOM, 2009; Rünk, 2009).

The seasonal dynamics of dissolved inorganic nutrients is controlled by the annual cycle of hydrophysical fields. The surface values are high in winter when water is usually mixed to the halocline. In spring and summer, when the mixed layer is thinner than the euphotic layer, plankton consumes nutrients and values drop below the determination limit. If there are warm weather conditions in the middle of summer and there is still phosphorus in the upper layer, it will be used up by blue-green algae that are able to fix nitrogen from air. As the nutrient-rich layer is separated from the upper layer due to a strong thermocline in summer, vertical transport of substances plays a very important role at that time. Vertical transport is highly dependent on the influence of atmosphere; for example, storms facilitate vertical mixing, whereas calm and sunny weather strengthens stratification even more. Upwelling is an important mechanism for vertical transport of nutrients. The amount of phosphate-phosphorus transported to the surface layer of the sea during an upwelling event that took place in August 2006 was measured around 500 tons by actual measuring (Lips *et al.*, 2009) and model calculations (Laanemets *et al.,* 2011), which is approximately equal to the monthly riverine load to the Gulf of Finland (HELCOM, 2004). A significant amount of nutrients is transported to the Estonian marine areas from neighbouring marine areas. Nutrients are carried to the Gulf of Finland from offshore Baltic Sea. This transport is more intensive when estuarial circulation is stronger, i.e. with eastern winds. In autumn and winter, vertical transport of nutrients to the upper layer is caused by thermal and wind-driven mixing. As the Gulf of Riga is separated from the rest of the sea with a relatively shallow Irbe strait, very nutrient-rich water under the halocline does not flow there from offshore Baltic Sea.

Long-term changes in nutrients are related to nutrient inputs to and outputs from atmosphere, rivers, neighbouring areas and sediments, and consumption. The long-term winter nutrient time series of the surface layer of the Gulf of Finland is very varied. The reason for this variability in not often clear. As regards nitrogen, somewhat lower values have been registered in recent years. As for phosphorous, the values have been bigger recently. It is likely that the increase in the content of phosphorous in the Gulf of Finland is not directly related to the growth of inflow from rivers and pollution sources. Higher values have occurred in the Gulf of Finland after the large inflows from the North Sea to the Baltic Sea in 1993 and 2003 (Lilover and Stips, 2008). These large inflows raised the halocline and increased stratification in offshore Baltic Sea as well as in the western part of the Gulf of Finland. As the halocline determines also nutrient clines, the inflowing water due to estuarial circulation has been richer in nutrients from the middle of the 1990s. This under-halocline water contains also less oxygen. Oxygen deficiency causes releasing of phosphorous from sediments. Hence, the higher values of phosphorus of recent years are probably related to the large inflow of the North Sea water that has caused an increased stratification and raised the halocline. The reason behind the great variability between annual time series is probably insufficient data, at least partly. Recent measuring experiments show that winter nutrient contents are relatively varied. This may be caused by temporary loss of stratification events, advection, upwelling, short-time production in the upper layer and other circumstances.

The rest nutrient cycles of recent years in the Estonian marine areas have been described based on the work of the Estonian Marine Institute of Tartu University (2012). The time series of the Haapsalu Bay nutrient concentration data series are incomplete, the difference in concentrations in Eeslaht Bay and Tagalaht Bay is large and data deviation is significant because of the small depth of the gulf. After commencement of regular monitoring of the Haapsalu Bay, the average concentrations of the total phosphorous have shown a constant growth tendency in the Haapsalu Bay

As in coastal waters, the average total phosphorus in offshore Baltic Sea has been growing. The total nitrogen content has been relatively stable in 1993–2003, although the trend has been growing in recent years. However, deficient data for the period of 2000–2004 and possible seasonal influence on the visits to stations in different times in different years must be taken into account. From the commencement of monitoring (1993), it has been detected that the decrease in the total phosphorus concentrations has stopped in the Pärnu Bay. The total nitrogen summer-time concentrations have not changed in this water body during the entire monitoring period.

The nutrient regime of the Gulf of Riga differs considerable from other parts of the Baltic Sea, the total nitrogen and phosphorous values compared to offshore Baltic Sea are double. The long-term trend of the open sea area of the Gulf of Riga is characterised by the increase in the concentration of total nitrogen, but concentrations of total phosphorus, regardless of low mean indicators measured in 2010, show a growing trend in all monitoring stations.

Deficiency of oxygen in the bottom layers of the Baltic Sea is an acute topic. Although hypoxia is a natural phenomenon in the Baltic Sea, it is believed that, at least partly, the extent of hypoxia is the result of anthropogenic eutrophication. Hypoxia exists in the deeper layers of the Estonian open sea areas (offshore Baltic Sea, in the Gulf of Finland and in the Gulf of Riga) and in the coastal zone in areas of high trophication. The hypoxic area of the Baltic Sea has grown during recent decades. In offshore Baltic Sea, the bottom waters are ventilated temporarily by the large North Sea water inflows, of which the last occurred in December 2014. In the Gulf of Finland, the effect of inflows is opposite: stratification increases and hypoxia deepens due to more limited vertical mixing. At the end of the 1980s, the oxygen values in the bottom layer were higher than after the middle of the 1990s. This period, which started with the great inflow of 1993, continues today. In the synoptic temporal scale, the functioning of the estuarial circulation has a major impact on the oxygen of the bottom layer of the Gulf of Finland. When estuarial circulation is intensive, the hypoxic area is larger in the Gulf of Finland, and if it is limited, it is smaller. Reversing estuarial circulation may eliminate hypoxia from the Gulf of Finland (Liblik *et al*., 2013, Figure 2.4). Changeability of circulation is caused by the seasonal nature of wind and stratification, making the hypoxic area larger in summer and smaller in winter.

Oxygen deficiency in the Gulf of Riga is local phenomenon, hypoxic water does not flow here from offshore Baltic Sea. Oxygen concentrations and the extent of the hypoxic area depend primarily on the local production and stratification. There is no strong stratification in the Gulf of Riga in winter, which means that hypoxia does not exist there either. Hypoxia occurs also in shallow coastal areas where there is high production and limited exchange of water.

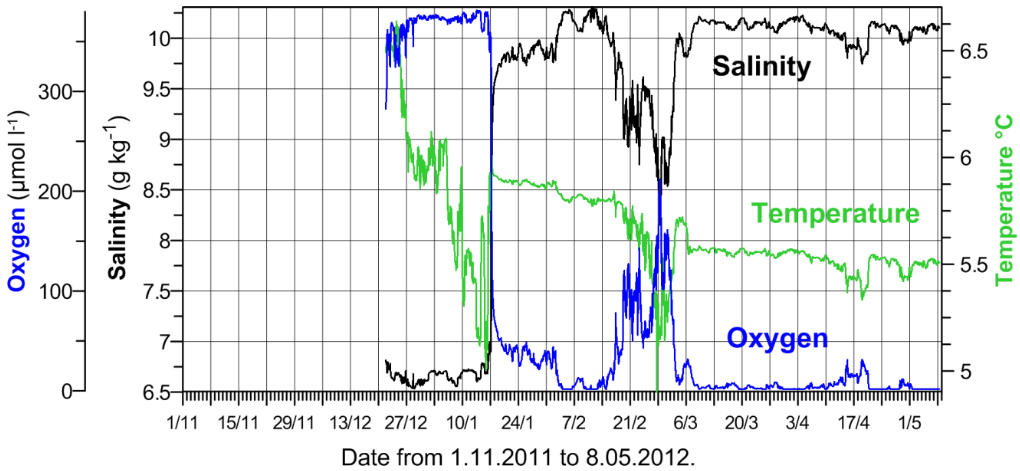

Figure 2.4. Time series of oxygen, temperature and salinity in the western part of the Gulf of Finland in the demersal layer at 87 m (Liblik *et al*., 2013).

Plankton

Phytoplankton
The most important factor that influences phytoplankton is enrichment of the marine environment with nutrients, or eutrophication. The increase of nutrient concentrations in seawater causes intensive algae blooms or growth of phytoplankton biomass.

Phytoplankton is characterised by seasonal dynamics. In the Baltic Sea, algae blooms usually occur in spring and summer and the timing and length of these blooms depend on the region as well as the particular year. While cold-water diatoms and dinoflagellates dominate in spring blooms, summer blooms may be caused by different groups of algae, of which the most widespread are green-blue algae or cyanobacteria (Jaanus *et al*., 2007). In autumn, the largest contribution may come from green-blue algae and dinoflagellates (TÜ Eesti Mereinstituut, 2011).

Weather conditions play the most important role in the plankton dynamics in a short-time perspective. Long-term changes are more or less related to the nutrient inflows from mainland and air. As regards water, nutrient loading or nutrients accumulated into sediments must be taken into account.

To assess the status of the marine environment, phytoplankton quantitative parameters are preferred, i.e. biomass calculated by cells per volume and seawater chlorophyll *a* content. These parameters are the basis of the assessment method that relays on Estonian coastal sea phytoplankton. Indicators that are based on the species composition are being developed. For the open sea, in most countries surrounding the Baltic Sea, including Estonia, the assessment system has not yet been developed.

According to the HELCOM (2009b) thematic report, the most eutrophic open sea areas, such as the Gulf of Finland and the Gulf of Riga and the northern part of the Baltic Sea, are adjacent to the Estonian coastal waters. According to the HELCOM method that uses chlorophyll *a* as the indicator, 80–100% of the Gulf of Riga and the Gulf of Finland and the northern part of the coastal waters and the open sea areas of the Baltic Sea get a poor or very poor ecological status score.

Based on the results of operative and general monitoring of the Estonian coastal waters and the assessment system established in Estonia, most of the coastal waters are in poor condition. An exception is the most eastern and western waters, i.e. the Narva Bay and Kihelkonna Bay, which condition is classified as good based on phytoplankton. Of the Estonian coastal waters, the Haapsalu Bay is in the worst ecological state.

Zooplankton
Zooplankton is an important link in the marine food chain, because juvenile fish stages feed on it. Some important commercial fish feed on zooplankton throughout their whole life. Both sea and fresh water species are represented in the zooplankton communities (TÜ Eesti Mereinstituut, 2011).

In the coastal sea and surface layers of the open sea (in summer above the thermocline) a large part of zooplankton community contains marine origin copepods, sometimes also rotifers, and in summer the number of cladocerans is relatively high (TÜ Eesti Mereinstituut, 2011).

In the deeper water layers (below the thermocline in summer), but also below the halocline (if the oxygen conditions are favourable), a significant part of the zooplankton communities is formed by large species like Arctic origin *Limnocalanus macrurus* and marine origin *Pseudocalanus acuspes*. The range and abundance of the latter is limited due to low salinity and *L. macrurus* population development depends mostly on the thermal regime of water. According to the marine environment assessment of 2012, the proportion of these species has greatly decreased and the proportion of brackish water species has increased (e.g. *Acartia* spp. and *E. affinis*) (TÜ Eesti Mereinstituut, 2012).

The zooplankton communities are very varying and respond quickly to changes (e.g. water salinity and climate change) in the ambient environment. Relatively recently it has been proved that there are links between some zooplankton species and phosphorus and nitrogen concentrations of seawater (Põllumäe and Kotta, 2007; Põllumäe *et al.*, 2009). Based on the existing studies, some zooplankton species respond to eutrophication of seawater (Põllumäe and Kotta, 2007; Põllumäe *et al.*, 2009). Currently, there are no indicators that help to assess the marine environment condition based on zooplankton in the Baltic Sea.

2.1.6 Benthos

Phytobenthos

The Baltic Sea brackish water is an extremely complicated environment for sea plants because of varied salinity conditions, different coast types and substrates and other environmental conditions, which is also the reason for relatively low diversity of the Baltic Sea phytobenthos. The number of macrophyte species, such as macroalgae, phanerophytes, charophytes and bryophytes is 531 in the entire Baltic Sea and 187 in the Gulf of Finland. These numbers are smaller for the Estonian coastal waters. Nowadays, altogether up to 60 species of macroalgae and about 20 mainly vascular plant species that are of fresh water origin can be found in the coastal waters of the western Estonia archipelago (Martin, 2000). The benthos of the Gulf of Finland in the Estonian coastal sea is even less diverse. In the Estonian coastal sea, the depth of the phytobenthos range is considered to be 20–25 m; however, red algae communities exhibiting a relatively high biomass have been described 35–40 m deep in Hiiumaa marine area.

In the Estonian coastal sea, plants grow 5–6 m deep on the soft seabed. The deepest areas are usually inhabited by charophyte communities. Phanerophytes dominate at depths lower than 1 m. Mixed communities of various fresh water phanerophytes inhabit areas influenced by fresh water inflows, whereas in more open areas can be found *Zostera marina* pastures.

Usually three well-developed plant zones can be identified on hard-substrate seabeds. There is a green-blue algae zone in the deepest zone which depth is determined by the fluctuation of water level. Mostly annual but fast-growing green-blue algae grow here. Communities with dominating perennial species can be found below the fluctuating water level zone. Most widespread key species in this depth zone is the bladder wrack (*Fucus vesiculosus*), which zones create living conditions for a large amount of other species. The bladder wrack communities are most diverse and represented in almost everywhere in our coastal sea (Figure 2.5). The most eastern limit of the bladder wrack communities range is the Letipea cape in the Gulf of Finland. The bladder wrack communities exist on hard seabed in Väinameri and the Gulf of Riga.

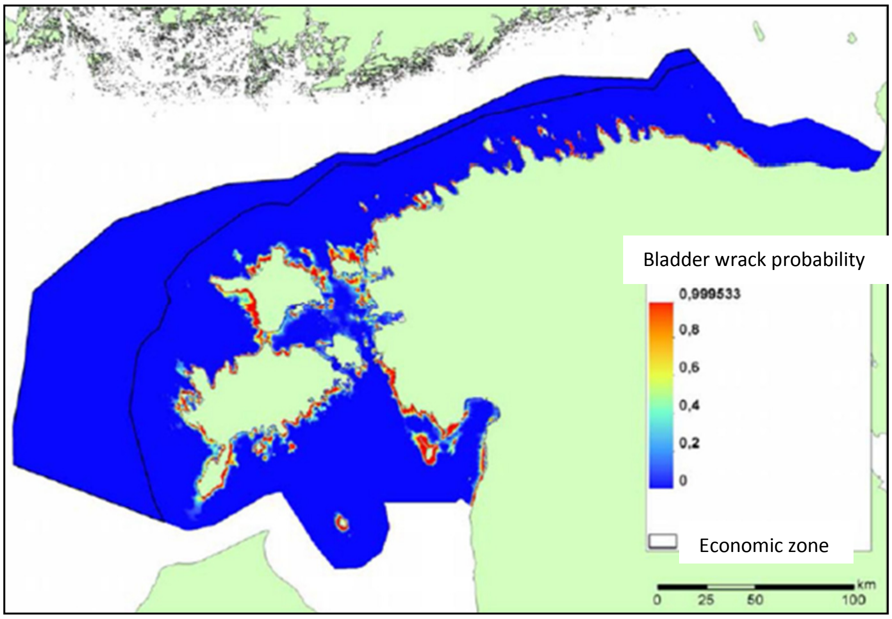

Figure 2.5. The modelled bladder wrack (*Fucus vesiculosus*) presence probability (TÜ Eesti Mereinstituut, 2011). Source: SEA, TÜ Eesti Mereinstituut, 2012b.

The red algae community with the dominant species *Furcellaria lumbricalis* dominates in deeper areas from 6–7 m. These communities are less diverse but may spread deep in favourable light conditions (the lower limit of plant range). Sometimes a species of brown algae *Sphacellaria arctica* or of a red algae *Polysiphonia fucoides* dominates in these communities. At certain depth, the algae community is usually replaced by the blue mussel community on the hard seabed.

A completely new macroalgae species in the Estonian coastal waters is a seaweed species *Fucus radicans* that has been described only in the Baltic Sea and was first found in the Estonian waters on 16 July 2008 in the phytobenthos monitoring area of Väike väin strait.

Phytobenthos has been used as a means to assess water quality for a long time. A coastal water ecological status assessment scheme has been developed in Estonia. According to the aggregate phytobenthos index, most Estonian coastal waters are in good state. This index also shows that the Haapsalu Bay is in a poor condition and the Matsalu Bay is in the worst condition.

Zoobenthos

While the range patterns of zoobenthic communities in the Estonian coastal sea depend on the region`s hydrology and the characteristics of sediments, in shallower coastal waters they also depend on the phytoplankton content in the water column, the nature of the phytobenthos communities and ice cover.

Currently, 128 zoobenthos species or groups live in the Estonian coastal area. The crustacean (*Crustacea*) species are most widespread in the Estonian waters. In addition to crustaceans, the typical zoobenthos species of the Estonian marine area are seawater and brackish water clams (*Bivalvia*), snails (*Gastropoda*) and polychaetes (*Polychaeta*). Hydrozoans (*Hydrozoa*), ribbon worms (*Nemertini*), priapulid worms (*Priapulida*), marine and brackish water oligochaetes (*Oligochaeta*), moss animals (*Bryozoa*), marine and brackish water snails (*Gastropoda*) and clams (*Bivalvia*) can be found in our marine area. Relatively often four fresh water species of snails and five fresh water insect groups are represented in the zoobenthos.

Above the halocline, the range of benthic communities is determined by three main factors – salinity, depth and type of seabed. Local factors are competition between species and, lately, human impact.

The clam colonies are characteristic to hard seabed areas, and depending on seawater salinity, the dominant species therein may be the bay mussel *Mytilus trossulus* (saltier sea) or the zebra mussel *Dreissena polymorpha* (less saline water).

The clam species that bury into sediments (the sand gaper (*Mya arenaria*) and the Baltic clam (*Macoma balthica*)) dominate in soft seabed areas. *Macoma balthica* is one of the key species of the Baltic Sea zoobenthos because of its range and great biomass.

Detritivores or animals that feed on detritus live usually in areas with muddy and clayey seabed and active sedimentation of organic sediments. Detritivores are the ragworm *Hediste diversicolor* and *Monoporeia affinis*.

Under the halocline, the range of zoobenthic communities is usually determined by oxygen conditions. In good oxygen conditions, such marine areas are usually inhabited by a diverse community where mainly dominate crustaceans *Monoporeia affinis* and *Pontoporeia femorata*, seldom the Baltic clam (*Macoma balthica*). In poorer oxygen conditions, only *Bylgides sarsi* (worm) can be found in such communities, because large invertebrates die in oxygen deficiency conditions.

A separate group is herbivores that mainly inhabit the phytobenthic zone. The characteristic large invertebrates in the Estonian coastal sea flora zone are *Idotea* (*I. balthica, I. chelipes*), *Gammarus*, the freshwater snails, the river nerite (*Theodoxus fluviatilis)* and *Radix balthica*.

To assess water quality in waters using the zoobenthos, Estonian Marine Institute of Tartu University has developed the zoobenthos community index ZKI, the hard bottoms index KPI and the habitat diversity index of phytobenthic zone FDI. The environmental condition of the waters calculated by the values of these indexes was good for the entire Estonian coastal sea in 2008–2010.

<u>Pressures</u>

The main pressures that influence the condition of the benthos are marine environment eutrophication, invasion of non-indigenous species and oxygen deficiency in deep sea.

Due to eutrophication of the Baltic Sea, the state of the zoobenthos has greatly changed during recent decades. The direct result of the eutrophication process is loss of benthic biodiversity, dominance of species that are less demanding regarding environmental quality and the growth of total zoobenthos biomass. The growth of total zoobenthos biomass is directly related to the improved food base of the zoobenthos due to the increasing amounts of organic matter contained in sediments during the eutrophication process. Following a decrease in water transparency, several phytobenthic species were lost, causing also a loss of several zoobenthic species that prefer plants.

The condition of the zoobenthos has been gradually improving in the Estonian marine area in this century. Restoration of plant communities has increased the diversity of the zoobenthos related to the phytobenthos in the Estonian coastal sea. An improvement of the condition of the zoobenthos has been detected also in the marine areas without flora due to a greater biological diversity of communities and the total biomass decrease.

In the marine area under the halocline, the composition of the zoobenthos is influenced by the oxygen regime in the demersal water. For the most part, the oxygen regime is influenced by the amount of saline water inflows to the Baltic Sea, although the extent of oxygen deficiency is also related to the general eutrophication of the sea. Poor oxygen conditions cause loss of the zoobenthos.

More intensive vessel traffic has brought many new species into the Baltic Sea in recent decades, of which most are invertebrates with an active pelagic larva stage. Much fewer new plant species have been registered. These species have mostly stayed in the saltier areas of the Baltic Sea. However, if current tendencies continue, it is not an impossible scenario that new plant species spread to the northern and eastern part of the Baltic Sea and non-indigenous species invade into the Estonian coastal waters.

2.1.7 Fish fauna

Highly migratory species

The only catadromous species in the Estonian waters is the eel. The eel feeds on water invertebrates and fish and goes to the Sargasso Sea to spawn (Pihu & Turovski, 2003). The stock of the European eel is at low levels and eel fishing is not sustainable. In 1938, an annual total catch of eels in the Estonian waters exceeded 500 tons, whereas in 2010 the catch of eels was 3.5 tons in the Estonian coastal sea. The reason given is small number of spawners (Dekker, 2003) which indicates overfishing in the entire range of the species. The abundance of eels is negatively influenced by dams that have been built on the eel migration rivers causing late migration or mortality (Bruijs and Durif, 2009).

The representatives of anadromous species are the salmon and the sea trout. They spawn in rivers and spend their adulthood in the sea. Salmon catches from the Estonian waters during 1981–2010 shows a decreasing trend. The number of allowed size salmon in the Estonian coastal sea depends on the catch of salmon originating from Estonia outside our economic zone. According to prognoses, the catches will remain on the same level in near future (Kesler *et al.*, 2011). Sea trout catches during 1999–2010 have shown a slight growing trend. However, salmon and sea trout catches include also introduced fish. An important factor that causes reduction in the numbers of anadromous species is dams on spawning rivers that restrict access to their spawning grounds. The reproductive success is influenced by the water level on the spawning rivers during the autumn and winter period. The abundance of wild fish is low and the fishing mortality rate can be considered moderate (Saat *et al.*, 2011). ICES has suggested that, for example, wild salmon should not be caught at all in the Gulf of Finland and the catch limitations on salmonids should be very stringent (ICES, 2011). The size of the stocks of salmonids in the Baltic Sea is not assessed.

Coastal sea fish

The coastal sea fish group includes marine species, such as viviparous eelpout, sea stickleback, broadnosed pipefish, straightnose pipefish, rock gunnel, lesser sand eel, great sand eel, black goby, sand goby, common goby, two-spotted goby, and longspined bullhead. Also fish that inhabit the Estonian part of the Baltic Sea (whitefish, vendace, northern pike, roach, common rudd, ide, chub, tench, common bream, white bream, crucian carp, Prussian carp, common carp, three-spined stickleback, European perch, zander, ruffe, bullhead etc.) of freshwater origin and semi-migrating fish (European smelt, vimba bream, sichel) can be classified as belonging to the group of coastal sea fish. Most species of the other functional groups are represented in the coastal sea. The number of large species is relatively small and their fishing pressure is moderate, but still very different by species (Saat *et al*., 2011). An exception is non-indigenous species Prussian carp and round goby that are strongly extending their range (Eschbaum *et al.,* 2011; Ojaveer *et al*., 2011). The factors that reduce the abundance are fishing mortality rate, pressure by great cormorants, hydrometeorological factors as well as overgrown spawning grounds (Saat *et al*., 2011; Vetemaa *et al*., 2010). Although there are less data on small size species, the pressures are the same (fishing pressure is random).

Demersal fish species

These are species which range extends outwards of the shallow coastal area. The European flounder and the Atlantic cod are the main species in the Estonian waters that are of commercial interest. The commercial stock of the Atlantic cod in the Estonian waters is still low and directed fishing activities for that stock are not economically feasible (Saat *et al.,* 2011). For the Atlantic cod, a pressure in the eastern part of the Baltic Sea is primarily hydrological processes, such as water exchange with the North Sea, but also other factors that influence salinity and oxygen content of the Baltic Sea water that are important for the Atlantic cod reproductive success in the Baltic Sea (HELCOM, 2006). In the Estonian waters, the European flounder is able to spawn in less saline areas near the coast (Ojaveer and Drevs, 2003), but their reproductive success is higher following an inflow of salty water. The monitoring data show that the stock of the European flounder has decreased in all the largest areas of the Estonian coastal sea, although the fishing mortality rate can be considered moderate. The reason for the decline of resources is deteriorating flounder spawns (Saat *et al*., 2011). With the current fishing mortality rate, no change is expected to occur in following years. The abundance of other species that belong into this group (common seasnail, shorthorn sculpin, lumpsucker, European plaice, turbot, fourhorn sculpin etc.) is different in the Estonian waters, where the turbot and the shorthorn sculpin are most abundant.

Pelagic species

The Baltic herring and the sprat are the typical small size pelagic species in the Estonian waters. Spring Baltic herring abundance in the Gulf of Riga is still high (although showing a decreasing trend), but low in other sea areas. Autumn Baltic herring is still in deep depression. The Baltic herring stock in the Estonia`s economic zone can be considered relatively good. The fishing mortality rate is high for both species (Raid *et al*., 2011; Saat *et al*., 2011).

ICES considers the intensity of exploitation of the Baltic herring stocks in offshore Baltic Sea and in the Gulf of Finland not to be in agreement with the sustainable yield (ICES, 2011b). Taking into account the above, one of the main pressures on small size pelagic fish is the fishing mortality rate, which will continue to be true also in future, influencing the biomass and the structure of the population (selective gear). In addition to fishing industry, the abundance is also influenced by the composition and abundance of zooplankton and hydrological conditions (HELCOM, 2006). An abundant species in the pelagic zone besides the Baltic herring and the sprat is the three-spined stickleback. Sometimes there may be random visitors (e.g. the European anchovy). The garfish is abundant in the Estonian waters seasonally. The abundance of the garfish is fluctuating, depending mainly on the natural and fishing mortality rate outside the Baltic Sea, but also on the temperature of surface water during the spawning period (Ojaveer & Järv, 2003).

Cyclostomes

There are two species in the Estonian waters: the European river lamprey and the sea lamprey, of these the latter occurs very seldom. Adult European river lampreys that inhabit the coastal sea have a parasitic lifestyle. The fish spawn in rivers once in their life. The abundance is stable. The condition of the European river lamprey is significantly better than in the rest of Europe. They are the target of commercial fishing activities during spawning migration in rivers and their fishing mortality rate is probably relatively high (Saat *et al.*, 2011).

As the fishing mortality rate as well as the natural pressure on the fish populations can be considered high, then according to the fish fauna parameters, good environmental status has not been achieved.

Pressures

The main pressures are the fishing mortality rate, destruction of and deteriorating conditions of habitats and spawning grounds and hydrometeorological conditions.

2.1.8 Wild birds

Most bird species in the north-western Europe, including the Estonian marine area, are migratory birds, and consequently the range and abundance of these species is mostly influenced by the factors outside Estonia. The reason for the changes in abundance may be the nesting conditions in Siberian tundra areas, influences at stops during migration or in wintering grounds in Western Europe or Africa. The number of species gathering in Estonia in winter is influenced by soft winters that occur more often after 1990, which is why more birds winter in the Estonian waters. Winter abundance of birds decreases because of massive mortality due to severe cold or diseases (Durinck *et al.*, 1994, Skov *et al.*, 2011).

Over 40 bird species nest in the Estonian coastal areas and on islets, of which many gather into nesting colonies. Even more birds gather outside nesting period to form moulting sites. Seabirds` moulting colonies are located on open sea shoals (common scoter, common eider) as well as in the coastal sea (common goldeneye, dabbling ducks, mute swan, greylag goose etc.). The autumn migration of birds from Arctic nesting grounds begins already in the middle of summer and lasts until the end of October. A remarkable congregation of sea birds happens in spring (spring migration) after melting of ice when in addition to our wintering birds other species that have wintered elsewhere fatten themselves here, such as long-tailed ducks, scoters, swans, geese and black geese that are headed to nest in the tundra.

Estonia has joined the Bonn convention and the Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA) (2008), the international framework agreements that deal with migratory species. In practice, an important shift has happened due to the HELICOM Convention on the Protection of the Marine Environment of the Baltic Sea Area.

The trends discovered during the work performed for the initial assessment of the Estonian marine areas (TÜ Eesti Mereinstituut, 2012) show great changes in the numbers of wintering waterbirds during recent 15–20 years. Especially large decrease has occurred in the abundance of Arctic waterbirds that winter on the open sea, such as the divers, the long-tailed duck, the common eider, the common scoter and the velvet scoter, and of coastal sea species the Steller's eider. The most important reason behind the decreased numbers is probably reproductive failure in Arctic nesting areas. During the autumn migration observation conducted on the Põõsaspea cape in Estonia in 2009, it was discovered that the percentage of young birds of the mentioned species is extremely small: the common scoter – 1%, the long-tailed duck 3%, the velvet scoter 6%, and the red-throated diver 8.5% (Ellermaa *et al.,* 2010).

An important component in assessing the Estonian marine area status is the diverse breeding bird species on islets and in the coastal areas. Altogether 42 waterbird and shorebird species nest in Estonia, of which 19 almost entirely on islands. Breeding birds like wintering birds are stationary for a long time, which means that they are greatly influenced by local pressures. Adding other bird species that nest in colonies (all the seagull species and the sterna, the tufted duck, the great crested grebe) as indicator species of MSFD to the common eider, the Sandwich tern and the cormorant should be considered to (Rattiste, 2006).

Pressures
The main pressures on birds are eutrophication, by-catching and oil pollution.

The current information about the range and abundance of waterbirds in Estonia could be considered good (breeding birds, coastal sea non-nesting period flocks) to satisfactory (open sea non-nesting period flocks) as a whole. Seabird research in the economic zone can be assessed as non-satisfactory, because it has not yet commenced.

In the Baltic Sea, oil pollution is the greatest risk to wintering birds, especially for long-tailed ducks, scoters and divers that gather on open sea shoals (Larsson & Tydén, 2005).

Birds get caught into fishing nets mainly during their migration or wintering period, when they gather into large flocks and feed on fish that are caught at the same time.

Eutrophication is also an important pressure that birds may respond to. Eutrophication may cause opposite changes in functional bird groups. For example, increased concentrations of dissolved nitrogen substances (DIN) cause a growth in the number of sea ducks that feed on molluscs, whereas reduction in the number of birds that feed on plants.

2.1.9 Protected natural objects and Natura 2000

Protected natural objects
According to § 4 of the *Nature Conservation Act*, the protected natural objects in Estonia are protected areas, limited-conservation areas, protected species and fossils, species` protection sites, individual protected natural objects and natural objects protected at the local government level. Protected areas are areas maintained in a state unaltered by human activity or used subject to special requirements where the natural environment is preserved, protected, restored, researched or introduced. This category includes national parks, nature conservation areas and landscape conservation areas.

As of 31 December 2014, there was altogether 3,895 protected nature objects in Estonia. According to the EELIS database (19.09.15), in Estonia there are

- 343 limited-conservation areas, of which 57 cover a part of the sea. In the Estonian waters, the largest limited-conservation areas are Väinameri (Hiiu, Saare, Läänemaa), Pärnu Bay and Kura kurk limited-conservation areas.
- 149 nature conservation areas, of which 23 cover a part of the sea;
- 149 landscape conservation areas, of which 31 cover a part of the sea;
- 5 national parks, of which 3 cover a part of the sea (Vilsandi, Matsalu and Lahemaa)
- 1,380 species protection sites, of which 11 cover a part of the sea.

Protected species fall into three protection categories. According to the *Nature Conservation Act,* in the protected category I belong species that are rare, in danger of disappearance that are located within restricted areas or whose population is thinly scattered over a more extensive range. In conditions where extinction in Estonian wild is likely if the adverse impact of the danger factors continue. Species that are in danger due to their small or reducing populations and whose range in Estonia is reducing due to overexploitation, destruction or damaging of habitats belong to category II. Species whose population is endangered by the destruction or damaging of habitats and has been reduced to a point where they are believed to move into the endangered category if the causal factors continue operating belong to III category. It is prohibited to disclose the specific location of the habitats of specimens of species in the protected categories I and II in the media. In Estonia, protected animal species of marine mammals are the grey seal (category III) and the ringed seal (category II). To protect gathering and reproduction area of these species, species` protection sites have been established in the Estonian marine area. The harbour porpoise belongs to protected category III, but in the Estonian water this species is very scarce. The white-tailed eagle that feeds on fish and waterbirds belongs to protected category I. Eurasian bitterns, tundra swans, whooper swans, greater scaups, Steller's eiders, smews, little gulls, lesser black-backed gulls, razorbills and black guillemots are waterbirds that belong to protected waterbirds category II. Fish that belong to protected category III are the European sea sturgeon, the spined loach, the bullhead. Waterbirds that belong to protected category III are red-throated divers, little grebes, red-necked grebes, barnacle geese, red-breasted geese, common shelducks, velvet scoters.

Natura 2000 areas

Natura 2000 is a network of protected areas of the European Union which objective is to ensure protection of rare or endangered birds, animals and plants and their habitats and sites. The Natura-network was established in 1992 and it consists of bird areas that are established to protect species included in Annex I of the EU Birds Directive and nature areas that are established to protect habitat types included in Annex I and species included in Annex II of the Nature Directive.

Natura 2000 areas in Estonia were selected by the time of accession of Estonia to the European Union in 2004. Of Estonian Natura 2000 areas, 89 nature and bird areas include also a sea part (Figure 2.6). Of these, 26 are bird areas that include a sea part with an area of approximately 6,500 km^2 and 63 nature areas that include a sea part with an area of approximately 3,900 km^2. The largest of Natura areas are Lahemaa and Väinameri nature and bird areas and Pärnu Bay and Kura kurk bird areas (EELIS: Keskkonnaagentuur, 15.09.15). There are also nature areas do not cover a sea part, but which border goes along the coastline and where many valuable continental habitat types are located. Such nature areas are, for example, Tahkuna, Aseri, Päite, Laulasmaa, Udria and other nature areas.

Designating an area as a Natura area does not mean prohibition of economic activity. Activities that do not significantly influence the protection objectives of the area are allowed on a Natura area. According to Estonian legislation, the environment impact assessment or strategic environmental assessment process is mandatory if the activity or implementation of the planning document may cause separately or together with other activities a presumed adverse effect on the protection objective of the Natura 2000 network and that is not directly related to the arrangement of protection of the area or is not directly necessary for that purpose.

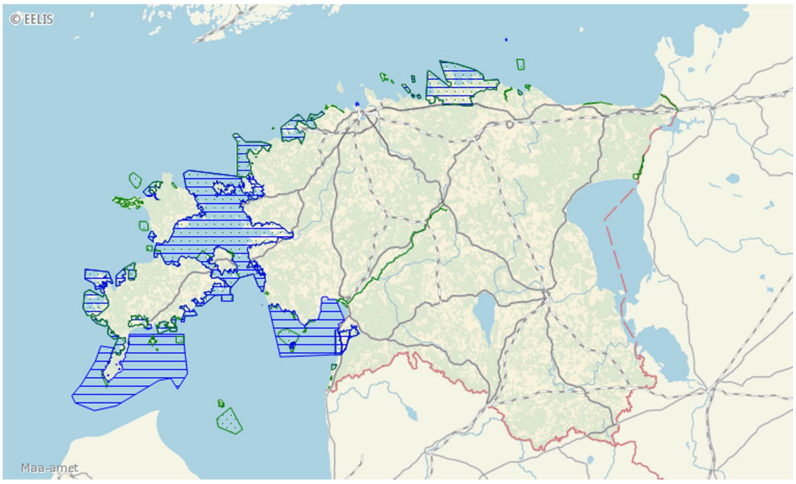

Figure 2.6. Natura 2000 bird and nature areas which territory includes also a part of the sea. Nature areas are shown in green, bird areas in blue (EELIS: Keskkonnaagentuur, 17.09.15).

According to the EELIS database (18.09.15), there are altogether 62 valuable habitat types on the Natura nature areas in Estonia. According to the "Manual of Nature Directive Habitat Types" (Paal, 2007), six of these are marine habitats. Marine habitats include sandbanks that are slightly covered by seawater all the time, estuaries, mudflats and sandflats not covered by seawater at low tide, coastal lagoons, large shallow inlets and bays, reefs. The most widespread habitat type in the Estonian seawaters are sandbanks. According to the EELIS database (as of 17.09.2015), sandbanks exist on 17 nature areas with a general area of approximately 396 km^2. Characteristic to these sandbanks are sandy sediments and depth of water that is seldom over 20 m. The benthos includes phanerophytes, charophytes and clams that bury into sediments (the common cockle, the soft clam, the Baltic clam). The sandbanks located in the nature areas have mainly high value or very high value and are usually well or very well preserved (EELIS: Keskkonnaagentuur, 17.09.15).

The land habitat types that exist on the Estonian seashore are beach ridges, perennial vegetation of stony banks, vegetated sea cliffs, saline mud and sand beaches, islets and small islands, coastal meadows, sandy beaches with perennial vegetation, foredunes, white dunes, grey dunes, brown dunes with *Empetrum nigrum*, dune hallows with *Salix repens* ssp. *argentea*, wooded dunes, humid dune-slacks, dry meadows on calcareous soil, alvars, forests of screes and ravines (cliff forests) etc.

The species listed in Annex II of the Nature Directive which habitats are protected and exist in the Estonian seawaters are the grey seal (*Halichoerus grypus*), the ringed seal (*Phoca hispida bottnica*) and the harbour porpoise (*Phocaena phocaena*) of mammals, and the spined loach (*Cobitis taenia*), the bullhead (*Cottus gobio*), the European sea sturgeon (*Acipenser sturio*), the twait shad (*Alosa fallax*), the vendace (*Coregonus albula*), the whitefish *Coregonus lavaretus* (Coregonus spp), the sea lamprey (*Petromyzon marinus*) of fish (Natura 2000, 17.09.15).

Of species represented in Estonia 65 species belong to Annex I of the Bird Directive, in addition also migratory species and other species of local importance. Estonia has to take into consideration about 90 species when selecting bird areas. (Natura 2000, 16.09.15) Species at the sea that also feed there and which habitats are protected on the Estonian bird areas are, for example, Eurasian wigeon (*Anas penelope*), mallard (*Anas platyrhynchos*), greater scaup (*Aythya marila*), Eurasian bittern (*Botaurus stellaris*), common goldeneye (*Bucephala clangula*), black guillemot (*Cepphus grylle*), long-tailed duck (*Clangula hyemalis*), Bewick's swan (*Cygnus columbianus bewickii*), whooper swan (*Cygnus cygnus*), mute swan (*Cygnus olor*), white-tailed eagle (*Haliaeetus albicilla*), common gull (*Larus canus*), lesser black-backed gull (*Larus fuscus*), velvet scoter (*Melanitta fusca*), common merganser (*Mergus merganser*), common eider (*Somateria mollissima*), Eurasian wigeon (*Anas penelope*), mallard (*Anas platyrhynchos*) etc.

In Estonia, all nature and bird areas that cover a part of the sea are located in the territorial sea. There are no Natura areas in the economic zone. In 2007–2011, the project “Implementation of Natura 2000 in Estonian marine areas – site selection, designation and protection measures – ESTMAR” was carried out together with Estonian Marine Institute of Tartu University. At the same time, other open sea banks research projects were conducted, e.g. inventory taking of the Gretagrund (2008–2009) and Krassgrund (2009–2010) biota that was led by Estonian Fund for Nature (Eestimaa Looduse Fond) and Environmental Board (Keskkonnaamet) project “Avifauna on north-western and western Estonia open sea shoals during non-breeding period” (2009) financed by Environmental Investment Centre (Keskkonnainvesteeringute Keskus) (Balti Keskkonnafoorum, 2011). During the projects, an inventory of the marine habitats and biota of Estonian shoals was taken and the assessments of more valuable marine areas was conducted based on the analysed information that is the basis for the establishment of new Natura areas. In 2014, a new project “Inventory and development of monitoring programme for nature values in Estonian marine areas (NEMA)” was launched. The objective of the project is to fill in the gaps in the current body of knowledge and understanding of marine habitats and distribution of endangered species. The activities of the project are focused on the development of the favourable status criteria of the marine habitat types of the Nature Directive and identification of their precise range in Estonia`s territorial sea and economic zone (Estonian Marine Institute of Tartu University web page: http://www.sea.ee/valisosalusega-projektid/nema, 18.09.15).

Risk factors

The main risk factors of marine habitat types are construction works on the particular marine area, such as construction of ports and wind farms and establishing waterways, but also excavation of mineral resources, marine pollution and eutrophication of the marine environment, and also overgrowing and drainage (Keskkonnaamet, 2009, 2011, 2012). The main pressures on the ringed seal and the grey seal are disturbance by humans, poor state of fish stocks, being killed in fishnets (Keskkonnaamet, 2011; Eesti Mereinstituut, 2012). Land habitats may be endangered by poor management or lack thereof; for example, suspension of grazing or no grazing that may result in overgrowing (Keskkonnaamet 2011b, 2012b). Oil pollution, ship and motor boat traffic, disturbing during breeding period, changes in food base threaten aquatic birds in bird areas (Keskkonnaamet, 2009, 2012).

Deficiencies
The Natura areas that are currently located in the Estonian marine area include only the territorial sea. There are no Natura areas in the economic zone.

In Estonia, various data sources are available about protected natural objects, including habitat types and species in the Natura areas. It is often the case that valuable data on habitats and biota (range, area, status, risk factors etc.) are included in different reports prepared during various projects carried out in Estonia, but the Estonian official database EELIS (Estonian Nature Information System) does not include these data. Valuable and important scattered data makes it difficult for nature experts to work and slows down their progress.

2.1.10 Marine mammals

There are three endemic species of marine mammals in the Estonian coastal waters: the grey seal (*Halichoerus grypus*), the ringed seal (*Phoca hispida*) and the harbour porpoise (*Phocoena phocoena*). At the beginning of the 20th century, these species were common everywhere in the Baltic Sea and in the Estonian waters. In the Baltic Sea, there were up to 80,000–100,000 grey seals and the number of ringed seals exceeded even 200,000 (Harding etc. 1999). Currently, the abundance of these species has dropped to 25% and 4% of their historic abundance, respectively. No specific data is available on the harbour porpoise. Probably, the species was not that abundant in the Estonian waters.

Grey seal
This is a very migratory species whose range is primarily linked to habitats. The range of the species during their breeding period is dependent on the presence of ice during that period (February–March). The main breeding grounds are located on the western and southern coast of Saaremaa, the eastern and central part of the Gulf of Finland, and more seldom in the northern coastal waters of Hiiumaa in normal and milder than average winters.

The data on Figure 2.7 show ca 8% annual increase in their abundance up to 2008. When comparing the Estonian data with the dynamics of the general numbers of the Baltic Sea, a similar deceleration of the growth trend is revealed, exhibiting a drop from eight per cent to a few per cent in a year.

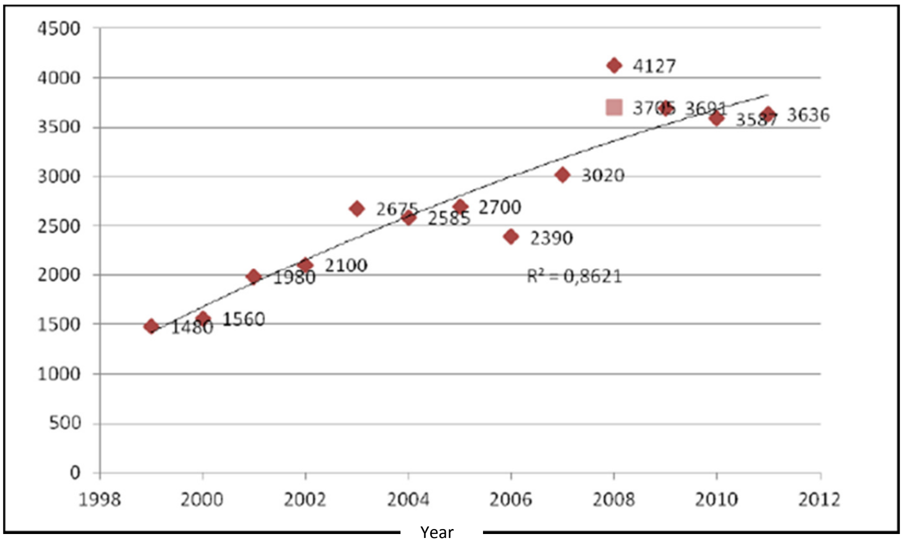

Figure 2.7. Grey seal abundance trend in 1999–2011 (TÜ Eesti Mereinstituut, 2012).

The status of the population of the Baltic Sea grey seal population that inhabits the Estonian coast has constantly improved over recent decades. The increase of their abundance is one of the indicators. According to the criteria of the International Union for Conservation of Nature (IUCN), the grey seal is in the least concern category. However, the species requires constant monitoring to avoid decline of the population`s status.

The health state of animals has not been studied in Estonia. According to the data of Swedish researchers (Bergman, 2007), the Baltic Sea grey seal population has decreased fat layer thickness which is one of the low body condition indicators. The direct reasons are unknown.

Fertility of female animals has also improved over two decades. The frequency of uterus pathologies has decreased and the percentage of reproductive females in population has increased. This is mainly associated with the decrease of environmental poisons (Bergman, 2007, Bredhult *et al*., 2008).

The continued problem is a high prevalence of colonic ulcers (Bergman, 2007) in the Baltic Sea population, which indicates immune and hormonal system deficiency. The prevalence of colonic ulcers may be caused also by environmental poisons (Sørmo *et al*., 2003, 2005). The cause for human-induced mortality is primarily by-catching, which extent is also unknown. It is estimated that the number may be up to two hundred animals a year in Estonia, of which most are young animals.

Due to a great decline in abundance, hunting of grey seals was prohibited in Estonia in 1972 (Keskkonnaamet, 06.09.2015). In Estonia, legal sealing was allowed in 2015, whereas in Finland and Sweden hunting has been allowed for years and this in concert with by-catching may be the reason for the deceleration in the growth of abundance.

Of natural factors, the abundance growth is influenced negatively by partial reproductive failure in warm winters. If there is not sufficient amounts of ice, grey seals give birth on land, where in high density conditions up to 50% of born pups die. If they give birth on the ice surface or in case of low population concentration, their mortality rate is up to 5% (Jüssi *et al*., 2008).

Ringed seal

In Estonia, ringed seals live mainly in Väinameri and the Gulf of Riga, and in smaller numbers in the Gulf of Finland. The known resting grounds are in Väinameri and on banks near the coast in the northern part of the Gulf of Riga. There are very few data about ringed seal abundance in the Gulf of Finland. According to the assessment of Russian researchers, there are less than 100 ringed seals and the population is in a critical state (Verevkin, 2011).

The population of the Gulf of Riga migrates regularly between the resting ground in Väinameri (spring and autumn) and the feeding grounds of the Gulf of Riga (summer). The breeding grounds are mainly in Pärnu Bay and in the northern part of the Gulf of Riga. The range during the breeding period depends on the existence of suitable ice types.

The abundance of ringed seals in the Estonian waters is estimated to be ca 1,000 animals (monitoring data of 2007–2008). In Estonia, no positive trend has been registered after the first counting that took place in 1994–1996. This indicates problems with animal fertility, repeated unsuccessful births in winters with small amounts of ice and possible by-catching in fishing gear.

The ringed seal population in the Estonian waters is mainly threatened by lack of ice cover due to warm winters or too fast degradation of ice. Females leave pups too early and the pups are unable to gather sufficient energy resources. In poor ice conditions, pups also fall prey of predators very often. The second direct risk is by-catching. Although there is not much data available, almost twenty ringed seals is thought to die in fishing gear annually.

Based on the above, the ringed seal population status can be considered unstable. The main pressures on marine mammals are lack of ice cover in warm winters, by-catching and pollutants.

2.2 Pressures on and status of the natural environment

When preparing "The Estonian Marine Strategy`s Programme of Measures" (SA SEI Tallinn *et al.*, 2015), the impact of various pressures by the descriptors of the Marine Strategy Framework Good Environmental Status and the environmental targets developed for achieving them in four subareas of the Estonian marine area (the Gulf of Finland, the Gulf of Riga, the Väinameri and offshore Baltic Sea) were assessed. The scores were given on a five-step scale, where 1 meant lack of impact of the pressure on achieving the relevant environmental target and 5 meant a material impact of the particular pressure on achieving the relevant environmental target. Based on expert assessments, the score of different pressures were calculated by marine areas at the GES descriptor level and the total score (averaged assessments based on the GES descriptor, the marine area and the entire table). Based on scores, the significance of the pressures on different descriptors was assessed (Table 2.1). In the following sections, we will describe the pressures in more detail.

Table 2.1. An aggregate table based on expert opinions about the significance of different pressures on achieving or not achieving environmental targets by GES descriptors in the Estonian marine area, 2014a (SA Säästva Eesti Instituut *et al.,* 2015).

Priority environmental problems in the Estonian marine area

Colour scale of pressures

5	Extremely important
4	Very important
3	Average
2	Not important
1	Not important at all

TOTAL ESTONIAN MARINE AREA		2014.a		Achievement of Good Environmental Status in 2014										
Pressure/environmental problem		Rank	Total score	Biodiversity D1	Non-indigenous species D2	Fisheries D3	Food web D4	Eutrophication D5	Sea bottom disturbance D6	Changed hydrology D7	Contaminants in water D8	Contaminants in food D9	Marine litter D10	Marine noise and energy D11
7. Nutrient and organic enrichment	7.1. Discharges of fertilizers and substances rich in nitrogen and phosphorous	1	2	4	3	2	4	4	2	1	1	1	1	1
8. Biological disturbance	8.3. Selective extraction of species	2	2	3	3	4	4	1	3	1	1	1	1	1
5. Contamination by hazardous substances	5.1. Introduction of synthetic and biologically active compounds to a waterbody	3	2	2	2	2	2	1	2	1	4	3	1	1
7. Nutrient and organic enrichment	7.2. Discharges of organic matter	4	2	3	2	2	3	3	2	1	1	1	1	1
5. Contamination by hazardous substances	5.2. Introduction of non-synthetic substances and compounds into a waterbody	5	2	2	2	2	2	1	1	1	4	4	1	1
8. Biological disturbance	8.2. Introduction of non-indigenous species and translocation	6	2	3	4	2	3	1	2	1	1	1	1	1
6. Systematic and/or intentional release of substances into the environment	6.1. Introduction of other substance, whether solid, liquid or gas, into a waterbody	7	2	1	1	1	2	1	1	1	3	3	2	1
2. Physical damage	2.1. Changes in siltation	8	2	2	2	2	2	2	3	2	1	1	1	1
2. Physical damage	2.3. Selective extraction	9	2	2	2	2	2	1	1	2	1	1	1	1
2. Physical damage	2.2. Abrasion	10	1	1	2	1	2	1	3	2	1	1	1	1
1. Physical loss	1.1. Smothering	11	1	1	2	1	2	1	2	2	1	1	1	2
4. Interference with hydrological processes	4.2. Significant changes in salinity regime	12	1	1	3	2	2	2	1	2	1	1	1	1
4. Interference with hydrological processes	4.1. Significant changes in thermal regime	13	1	1	3	1	2	2	1	2	1	1	1	1
5. Contamination by hazardous substances	5.3. Introduction of radio-nuclides into a waterbody	14	1	1	1	1	2	1	1	1	3	3	1	1
3. Other physical disturbance	3.2. Marine litter	15	1	1	1	1	1	1	2	1	2	2	3	1
1. Physical loss	1.2. Sealing	16	1	1	2	2	2	1	2	2	1	1	1	1
8. Biological disturbance	8.1. Introduction of microbial pathogens into a waterbody	17	1	1	2	1	2	1	1	1	1	1	1	1
3. Other physical disturbance	3.1. Underwater noise	18	1	1	1	1	1	1	2	1	1	1	1	2

2.2.1 Physical damage: siltation, smothering, elimination, sealing, changing the coastline

Table 2 of Annex III of the Marine Strategy Framework Directive highlights changes in siltation processes as an important pressure. The mentioned changes in the marine area sedimentation processes may be caused by several human activities, including changes in water motion, changes in the trophic level of the marine area, but also varying climatic conditions that bring precipitation and therefore also increase inflow of freshwater. The expert group of the initial assessment of the Estonian marine areas (TÜ Eesti Mereinstituut, 2012) did not find any data that would help assess or describe the extent of this pressure in the Estonian marine area.

In the Estonian marine area, building hydrotechnical constructions and dumping operations can be considered a type of smothering during which the dredged material is dumped into the sea. In Estonia, official dumping sites are used (Figure 2.8), where usually the material gathered during dredging is disposed of. In recent years, the environmental impact assessments have often suggested to avoid dumping in very shallow areas, for example, in Väinameri. So the material that has been gathered during dredging of Kuivastu, Virtsu and Heltermaa ports have been transported out of Väinameri. The impact of smothering depends on the amount of dumped material, its integration and the hydrodynamic characteristics of the dumping site. The greatest impact of smothering operations occurs when the work is carried out because of suspended particulates that form in the water column and cause decline of light conditions and the benthos is buried under the dumped ground. The content of nutrients may also somewhat increase, but to assess the extent of its specific impact on the production requires additional research. Several dumping sites in use are located much deeper than the euphotic zone which means that there is no phytobenthos. However, suspended particulates may drift with currents from the dumping area to shallower waters. Restoration of the benthos is presumed to take 2–3 years. For example, regardless of repeated dumping operations in Aksi dumping site, monitoring has revealed that dumping operations have not damaged the region`s benthic communities (TÜ Eesti Mereinstituut, 2011). Consequently, dumping operations have had a negative environmental impact, but it is reversible. The impact of establishing hydrotechnical buildings is permanent, because instead of natural seabed quays, breakwalls (Pärnu), walls (Kuressaare) and other structures are constructed. However, taking into account the length of Estonia`s coastline, the ratio of man-made coastal zones is not very large. The largest artificial costal zones are ports in Tallinn region and in Muuga and the dyke of Väike väin strait.

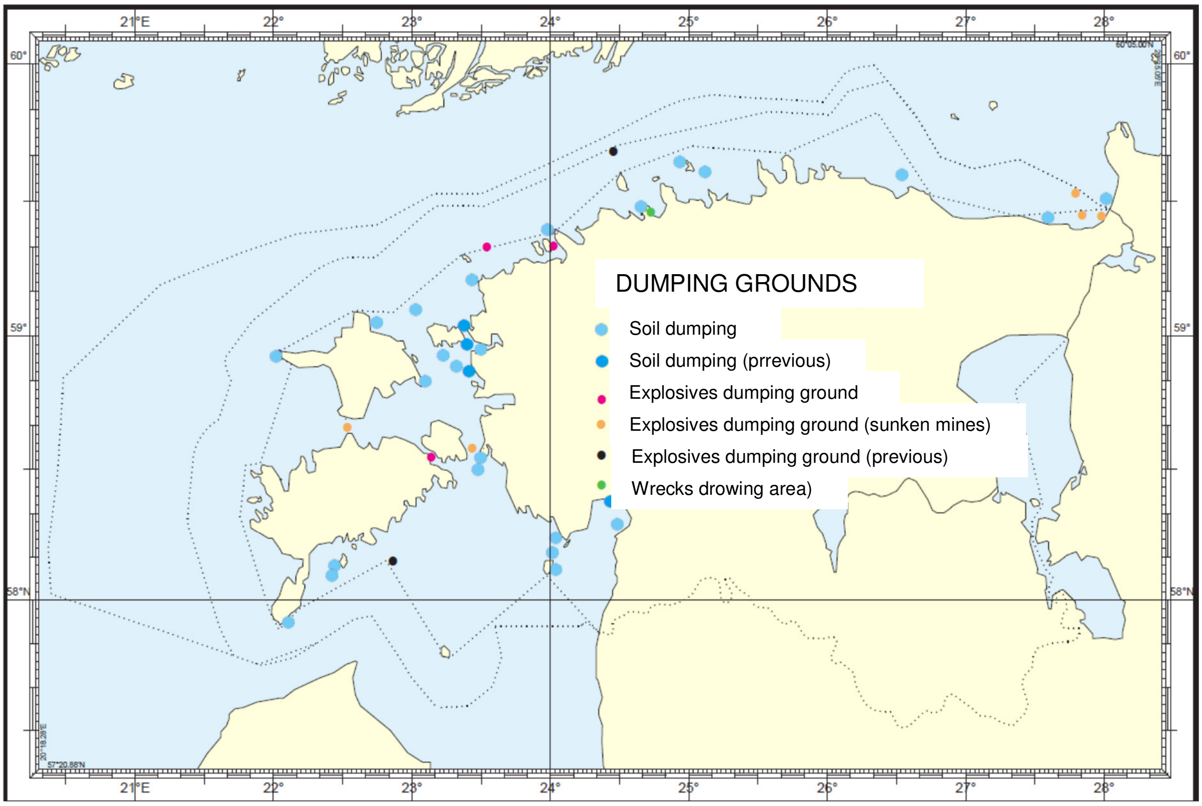

Figure 2.8. Dumping sites in the Estonian marine area. The map has been prepared by Anu Heinsaar, a chief specialist of the cartography department of the Estonian Maritime Administration, 2015.

Man-made hydrotechnical structures that have been erected in the coastal zone (shore protection installations, wave breakers, breakwalls, boat landings, sea cables etc.) can change (seal) the conditions of currents and waves and movement of sediments. In several segments of the Estonian coastal zone, water motion is restricted and accumulation of sediments has intensified. The situation is usually opposite on the other side of the obstacle where due to deficit of sedimentation abrasion processes have intensified. Blocking of movement of sediments due to human activity usually occur when obstacles are built in the coastal zone (breakwalls in ports and estuaries). In recent decade, the coastline has most changed in the neighbourhood of the largest ports (Paldiski South and North Port, Muuga, Toila etc.). Sediments pile up in the region of breakwaters that have been built in estuaries. Significant amount of sediments has accumulated behind the breakwalls constructed in the mouths of River Pärnu and River Narva. The sea bottom is also sealed by dredging ground from port basins and waterways. Usually the impact on the coastal processes is greatest in dynamic regions with intensive transport of sediments where repeated dredging is required because of clogging of waterways. Such harbours are, for example, Lehtma, Nasva and Naissaare harbours. The impact of hydrotechnical structures on currents and waves is usually local and does not have an extensive impact on the general circulation of large water bodies, such as the Gulf of Riga or the Gulf of Finland. Local impacts are greater in Muuga and Tallinn ports, near Pärnu breakwalls, close to Kuressaare fairway walls. Construction of dykes has a strong impact. The most remarkable example of this impact is Väike väin dyke that has created a situation where salinity of water north of the dyke is 6–7 g/kg and south of the dyke is 5.5–6.5 g/kg. Because of regulated salinity, it is likely that it has influenced also biogeochemical indicators and the entire biota.

Greatest changes due to physical elimination of sea bottom is related to dredging and excavation operations. Dredging is carried out when ports are built and extended, but also to keep ports operational. Recently, the largest volumes are associated with the extension of the dredged Muuga port. Mineral sand is mainly excavated from the sea which demand occurred in the middle of the 1990s because ports were extended. The volume of excavation has been described in section 2.1.3. In 2007–2011, permits were issued for dredging, filling, dumping, excavation of earth material and mineral resources for 26.8 million cubic meters based on special water permits (according to the register of environmental permits) (SA SEI Tallinn *et al.*, 2015). The total area influenced by these developments has not been assessed. The factors that influence the general condition of the marine environment during dredging and excavation operations are formation of suspended particles, decrease of transparency, destruction of zoobenthos, increase of trophicity and possible changes in the composition of zoobenthic species and biomass of zoobenthos. Additional changes are related to the bottom relief and current and wave regime. Research has shown that the impact of excavation on zoobenthos is short term, but the aftereffect may last up to two years. Communities recover by immigration from neighbouring areas. A potential impact on the structure of fish communities, fish stocks, spawns and fisheries is usually related to the formation of suspended particles, but also changes in the bottom substrate (elimination). Monitoring efforts after excavation and dredging operations have shown that the impact on the environment is significant but short term (around two years) and is primarily local in nature. An exception is port basins and nearby marine areas and fairways. The depths are controlled in the basins and fairways (if necessary with repeated dredging). This means that the sea bottom is there deeper than neighbouring marine areas due to human intervention. Depending on the depth of the port and on the communities inhabiting the area, dredging may locally change the benthos as a result of declining light conditions. In addition, due to heavy traffic, there may be more suspended particles in ports that deteriorate light conditions and settle down on the biota (including spawns). The described impact may also be present for fish as well as phytobenthos and zoobenthos.

The impact of covering the sea bottom by dumping lasts up to two years. The most influenced is benthos, but indirectly also fish fauna. The duration of the e on light conditions and nutrient content is shorter. Significant impact on coastal processes has not been detected. When covering the sea bottom with hydrotechnical structures (quays, breakwalls, walls), the ensuing influence is permanent, but usually local.

Hydrotechnical structures and dredged ports and fairways have a long-term, although usually local impact on currents and waves. The impact on coastal processes may extend further in space if the movement of sediments is active and frequent dredging operations are required. Due to artificial sediment deficiency, the coastal abrasion process may be intensified. The impacts on benthos and fish fauna may not be reversible, but they are very local (port basins) and have no great weight in terms of the entire Estonian marine area. An exception is Väike väin dyke that divides the Gulf of Riga and Väinameri and strongly influences water exchange, physical and biogeochemical factors and biota.

Dredging and excavation can have material impacts on the coastal processes, water column light field, distribution of nutrients, plankton, benthos and fish fauna. The impact on the biota is estimated to last up to two years.

2.2.2 Underwater noise

Many marine organisms, including most marine mammals and many fish species use sounds for various purposes, such as for communication, finding a partner, searching for prey, avoiding predators and risks and navigation. Depending on the intensity and frequency of the sound generated by the source of noise and the distance between the source of noise and the receiver this sound may potentially influence marine organisms in different ways.

Underwater noise as a pressure is suggested to be assessed using two indicators: (1) temporal and spatial distribution of strong, low and middle frequency short-time sounds; (2) constant low frequency noise.

In the impact assessments of underwater noise, human activities that generate sounds at frequencies that coincide with the hearing range of marine organisms are important. An exception is very strong sounds in which case the peak sound pressure is more important than frequency (OSPAR, 2009).

The main source of constant low frequency noise is vessel traffic, including sonars. The main strong short-term anthropogenic sound sources is pile-driving during construction works and explosions, including explosive ordnance disposal or shooting exercises.

Currently, there are no monitoring data about underwater noise in the Estonia marine area that would allow to assess the anthropogenic noise impact in this marine environment. No information has been gathered in Estonia about pile-driving when ports are being built. The volume and distribution of sound caused during these works has not been measured. No requirements have been imposed in Estonia on the measurement of underwater noise. Recently, an underwater noise study in the Baltic Sea was launched. The objective of the EU environmental projects financing facility LIFE+ project “Baltic Sea Information on the Acoustic Soundscape (BIAS)” is to measure anthropogenic and natural underwater noise in the Baltic Sea in different seasons during 2014–2016. The data is gathered by 40 measuring stations that are installed in the sea and the plan is to compile a soundscape map for the entire sea (GASUM *et al.,* 2015).

Indirectly, the potential impact of noise can be assessed by the distribution of sound sources. The sources of short-time strong sounds are mainly related to the construction of ports and explosion works. A constant low frequency sound is mainly related to traffic, but also dredging operations. There are no operational wind farms in the Estonian marine area.

HELCOM has compiled maps on possible distribution of sound caused by traffic and water sports (HELCOM, 2010; Figure 2.9). The premise of the assessment of the traffic noise level is its dependence on the intensity of traffic (only those with Automatic Identification System have been taken into account). The highest noise level based on the intensity of traffic in Estonia are the Tallinn Bay and the Muuga Bay regions. Underwater noise is higher than the background also in the Paldiski Bay and along Rohuküla-Heltermaa and Virtsu-Kuivastu waterways. In the open sea, the highest noise level is present in the waterway region that leads from the open sea of the Baltic Sea to the Gulf of Finland ports, especially when it crosses the Tallinn-Helsinki shipping line.

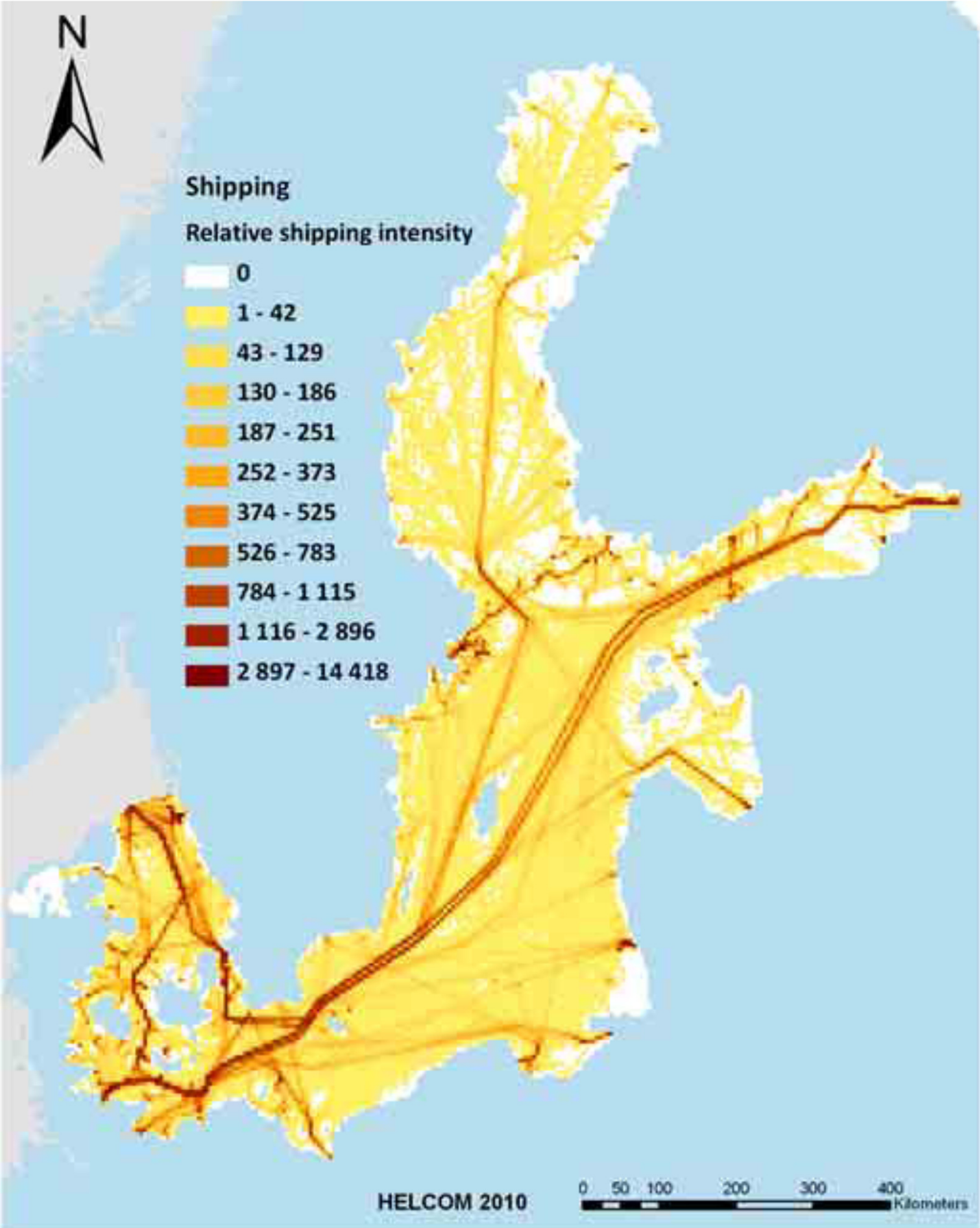

Figure 2.9. Shipping intensity on the Baltic Sea, HELCOM AIS data from 2008 (HELCOM, 2010).

Watersports-related underwater noise assessment is based on the premise that it depends on the existing facilities and density of human population. It has also been assumed that most activities take place near harbours. There are no published data about noise measurements related to watersports in the Estonian coastal sea. According to the assessment of HELCOM, the area most disturbed by water sports generated noise would be the Tallinn Bay region, followed by the Pärnu Bay.

Explosions to create waterways have been used earlier (for example, Rohuküla-Heltermaa waterway). Mine clearance operations in the Estonian waters have been carried out since 1994.

According to the information provided by the communication department of the Headquarters of the Defence Forces, over 600 mines had been defused by the end of 2009 during clearance operations that take place almost every year.

Underwater noise has been assessed during various environmental impact assessments conducted for various property developments. In the environmental impacts assessment on Saaremaa permanent connection it was found that the loud noise that is generated in the course of the construction of the bridge and the tunnel might influence the success of fish reproduction (disturb spawning or migration to spawning grounds) during the construction year (Eschbaum, 2009). The extent and significance of the impact can be assessed if the construction time and forecast noise levels are known. The fish species that permanently live in the Suur väin strait region are probably already used to ship generated noise (ferry traffic) and it is not very likely that exploitation of the bridge would significantly increase underwater noise (Eschbaum, 2009). During the construction phase of the bridge, the biggest disturbance factor for seals is high level of sound which is caused by intensified traffic, pile-driving etc. (Jüssi, 2010).

When the environmental impacts were assessed for the Nord Stream (Nord Stream, 2009) gas pipe, it was established that the higher levels of underwater noise and vibration caused by construction works might influence fish and marine mammals. The impact of construction noise on fish is considered insignificant because only the local fish population is impacted. As fish adjust to noise over time in nature, it is presumed that the noise generated by operating gas pipes does not have any impact on the fish range in long term. Dredging noise is believed to have about 1 km wide response zone for seals. In relation to explosive ordinance disposal it is presumed that seals` response zone extends 2–3 km from the site. It is mentioned that explosive ordinance disposal is a usual activity on the Baltic Sea and that most marine mammals avoid close proximity due to ship traffic. The impact of noise on marine mammals caused by operational gas pipes is considered unimportant because the frequencies are lower than the frequencies detected by stationary marine mammals.

In the impact assessment of Balticconnector gas pipe construction, it is mentioned that underwater noise during construction is an important risk on marine organisms, especially in coastal areas. The impact of exploitation and maintenance of the pipe was considered insignificant (GASUM *et al.*, 2015).

The studies (Vabø *et al.*, 2002; Handegard *et al.*, 2003) referred to in the strategic environmental assessment of county planning of the marine area bordering Hiiu County have pointed out that the frightening impact on fish of ship noise has been observed (Alkranel *et al.*, 2015). Strong noise may damage fish hearing capacity temporarily or permanently (Smith *et al.*, 2004¸ Thomsen *et al.*, 2006). The stress level of fish that live in regions with more intensive vessel traffic may be higher (Wysocki, 2006) and several bodily indicators different than usual (Graham & Cooke, 2008).

Based on literature, it has been assessed that wind generators may have a significant impact in terms of underwater noise on different fish species 1–4 km from the generators (Alkranel *et al.*, 2015). According to Bergström *et al.* (2012), any work performed during the construction of off-shore wind farms may cause changes in fish behaviour (primarily fish go farther away from the source of sound) depending on the hearing sensitivity of fish from one to several kilometres from the sound source. Physical damage to and death of fish can be primarily be caused by pile-driving, and this in case, if fish are closer to the source than 100 m during pile-driving operations (Bergström *et al.,* 2012).

A study of echo sounding of harbour porpoise conducted on a construction site in the open sea of the North Sea has shown that harbour porpoise response zone to pile-driving noise exceeded 20 km (Tougaard *et al*., 2009). Tougaard *et al.* (2009b) considered unlikely, based on the measurements of underwater noise caused by different wind turbines (in Denmark and Sweden) during their usual operation, that the noise would exceed the dangerous level for harbour seals or harbour porpoises at any distance from the turbines and that the noise could mask the acoustic communication of seals or harbour porpoises.

The local fish fauna may be influenced by noise caused by shooting exercises. The strength of the impact is hard to determine because there is relatively little research on this topic.

Noise created by ships and hydrotechnical and explosion operations has a negative impact on fish fauna and marine mammals. Currently, there is no data to determine the quantitative impact for the entire Estonian marine area.

Outdoor noise propagation has been described in section 2.3.6.

2.2.3 Nutrient enrichment

The Baltic Sea that lays between developed industrial and agricultural countries is a sea with one of the greatest pollution loads. Nutrient and organic substance inputs into the Baltic Sea originate from many local sources and from diffuse pollution sources. Limited water exchange with the global sea causes accumulation of these compounds in the Baltic Sea. From the 1970s, enrichment with nutrients and organic substances of the sea has been a growing problem.

The development strategy "Estonian Environmental Strategy up to 2030" considers enrichment of seawater with nutrients and organic compounds one of the main problems that causes eutrophication and undesirable condition of the Estonian coastal sea. In order to achieve and maintain a good condition of the coastal sea, it is necessary to reduce the amount of nutrient and organic substance inputs originating from economic activity into the sea that may decline the ecological condition of the coastal sea; ensure sufficient treatment of wastewater inputs to the sea; ensure collection of wastewater (including sewage) from ships in ports and ensure strict following of established restrictions.

Nitrogen and phosphorous compounds or biogenic compounds are nutrients that limit plant growth. When these compounds, organic or inorganic, are released into a body of water, the primal production of the waterbody will increase, which in turn increases sedimentation process of organic substance. Combined with added nutrients and organic substance, the composition of flora and fauna is changed. All these changes that are caused by added nutrients is called eutrophication of a waterbody. The inputs of nitrogen and phosphorous into the Baltic Sea from rivers and point sources has reduced in the past two decades (Figure 2.10).

Nitrogen and phosphorous compounds are released into seawater by various ways. A large amount of nutrients is carried into the sea by rivers, whereas in some waterbodies point pollution sources play an important role (including effluent of larger cities). In addition to these direct pollution sources, nutrients are carried to our sea area by currents from the waters of neighbouring countries (including water from River Neeva that flows into the eastern part of the Gulf of Finland).

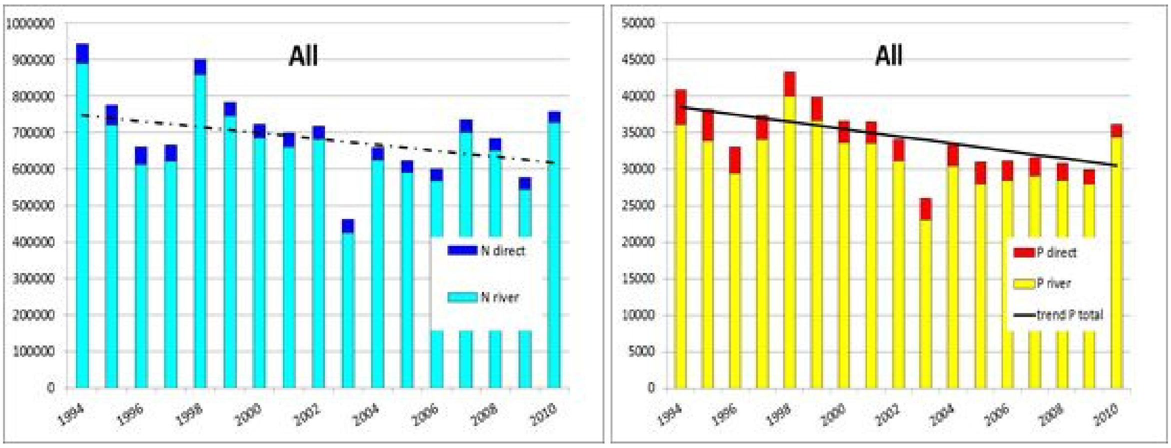

Figure 2.10. Nitrogen and phosphorous inputs into the Baltic Sea from rivers and point sources (HELCOM, 2013).

Atmospheric deposition accounts for a smaller portion of nutrients (Figure 2.11), i.e. about one fifth of total nitrogen load and 5% of total phosphorous load. Most of it is land-based. According to the assessment given to the Gulf of Finland, 12% of nitrogen depositions into the sea is caused by exhaust gases from ships (Raudsepp *et al.*, 2013).

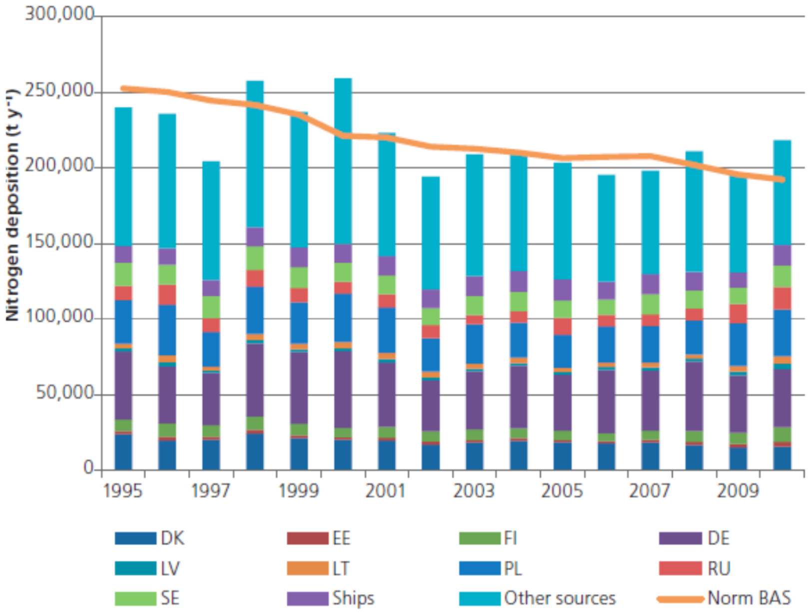

Figure 2.11. Nitrogen deposition into the Baltic Sea originating from HELCOM countries, other countries and ships (HELCOM, 2013).

Based on the data of national environmental monitoring, the point sources of pollution in Estonia during 1992–2004 showed a decreasing trend. The decrease was especially steep in 1992–1994. The decrease of the pollution load in the beginning of the 1990s was, for the most part, caused by the reduced production activity. The further decrease in pollution is related to updating of production, construction and renovation of treatment plants and improved legislative drafting and increased pollution charges. However, the trend of nitrogen and phosphorous compounds in the rivers that flow into the Estonian coastal sea has been slightly decreasing in 1992–2004 (TÜ Eesti Mereinstituut, 2012).

In the overview of HELCOM (2013) about the pollution load of the Baltic Sea, there are presented trends of nutrient loads originating from the Member States` rivers and point sources (Figures 2.12 and 2.13). Although there is no reliable trend for 1994–2010 on nitrogen originating from Estonia, the phosphorus input has decreased. As regards our neighbouring countries, a statistically negative nitrogen input trend is characteristic to Sweden and Latvia, whereas there is no reliable trends for Finland and Russia. As for phosphorous, Finland and Sweden had a negative trend, whereas no reliable trend is available for Russia, and Latvia had a positive trend.

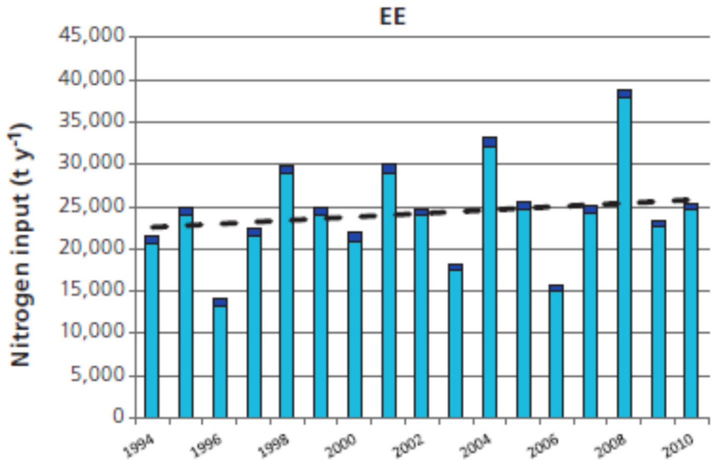

Figure 2.12 Estonia`s nitrogen input from rivers and point pollution sources (HELCOM, 2013).

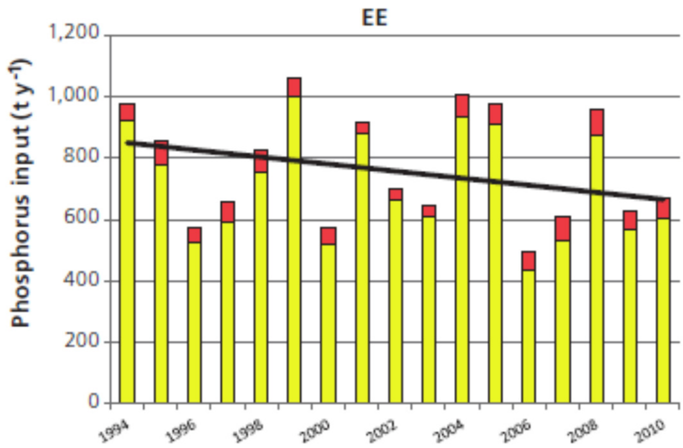

Figure 2.13. Estonia`s phosphorous input from rivers and point pollution sources (HELCOM, 2013).

There is no reliable trends about both nutrient inputs into the Gulf of Finland by every waterbody. The nitrogen trend of the Gulf of Riga is unreliable and there is a positive phosphorous trend.

Based on the existing data, it is difficult to assess how large amounts of nutrients may be input into the Estonian coastal sea without causing major and not reversible changes in the biota. On the one hand, the strength of impacts is related to the amount of input nutrients into the sea; on the other hand, the water exchange of the waterbody. Increased water exchange of a waterbody increases the solution effect of pollutants and the impact of nutrients on the marine environment decreases (TÜ Eesti Mereinstituut, 2012).

As discharged nitrogen and phosphorus-rich substances is the main cause of eutrophication of the Estonian coastal sea, the status assessment of the existing marine environment (TÜ Eesti Mereinstituut, 2012) clearly shows that input nutrient amounts are too large for the Estonian coastal sea and the status is assessed to be unsatisfactory based on this indicator.

2.2.4 Inputs of organic matter

Mineral nutrients and organic matter inputs into the sea as all other bodies of surface water mainly come from dry land. Organic matter is input into the sea mainly by flowing waterbodies (rivers, streams, effluent inlets, stormwater that washes the ground), whereas input by atmospheric deposition is usually small and generally insignificant. At the same time, the primary production of organic matter occurs in the sea by planktonic and benthic algae and plants that grow in shallow waters close to the coast (reed etc.). The rest of the marine biota lives on the organic matter synthesised in the sea (autothonic) and input into the sea (allothonic) from outside, such as bacteria, microzooplankton, mesozooplankton and macrozooplankton, benthic organisms, fish, marine mammals and birds. Human activities cause not only an input of inorganic nitrogen and phosphorous, but also organic substances into the sea. The most important anthropogenic organic pollution sources are inlets of untreated or poorly treated effluents, in certain cases stormwater that flows into the sea and activities that cause soil erosion (construction, dredging, dumping). Organic pollution originating from ships (wastewater, litter) is little.

Nutrient and organic substance enrichment of seawater is one of the most widespread results of human activity that influences seas nowadays. Nutrients and organic substances are input into the Baltic Sea from various local sources. Diffuse pollution has also to be taken into account. Limited exchange of water with the global sea causes accumulation of these compounds in the Baltic Sea. From the 1970s, enrichment with nutrients and organic substances of seawater has been a growing problem (TÜ Eesti Mereinstituut, 2012).

The consequence of input of excess nitrogen and phosphorous into the Baltic Sea of anthropogenic cause is excessive and unlimited growth of algae and production of organic substance (algae mass) that exceeds the self-cleaning capacity of the sea which leads to accelerated eutrophication of the Baltic Sea. Excessive primary production changes significantly the conditions of the sea as a living environment, because transparency of water decreases, stratification of the water column due to temperature intensifies, organic sediments accumulate, oxygen in demersal water is used up by degradation process of algae remnants, toxic intermediates (sulphur hydrogen, ammonia) are emitted when decomposition of organic substances is incomplete due to oxygen deficit. Siltation on the sea bottom leads to oxygen deficit which causes loss of habitats suitable for benthos. This all leads to the decline of biodiversity of marine biota, decrease or destruction of more valuable commercial fish populations and general reduction of seawater quality. An excess of organic substances may directly disturb human life in areas directly neighbouring the sea; for example, the sea with excessive decomposing organic substances smells. The above listed changes influence also the use of sea by people for recreational purposes. In order to better contribute to the improvement of the state of the Baltic Sea, the Estonian Environmental Strategy to 2030 (http://www.keskkonnainfo.ee/failid/viited/strateegia30.pdf) has acknowledged that enrichment of seawater with nutrients and organic substance is one of the main problems that causes undesirable eutrophication of the Estonian coastal water. To achieve and maintain good coastal water condition of the Baltic Sea that has been set down as one of the targets of the Water Policy Framework Directive, it is necessary to reduce significantly the amount of nutrients and organic substances that are input into the sea due to the economic activity, ensure sufficient treatment of wastewater inputs into the sea, receipt of waste (including sewage) generated on ships in ports and strict fulfilment of established restrictions. If the above are not ensured, the target of good state of coastal water is not achievable.

The amount of organic inputs are not directly measured by monitoring programmes. The content of organic substance in water is often measured by biochemical oxygen demand (BHT_5 and BHT_7). As organic substance in mainly input into the Estonian coastal water through rivers and point pollution sources, measuring of organic pollution (load) is primarily conducted within the framework of riverwater quality monitoring programme that was introduced in Estonia in 1992. The hydrochemical monitoring of rivers is included in the national environmental monitoring programme since 1994. The sampling points of rivers` hydrochemical monitoring have been chosen so as to determine the outflow of pollutants from rivers into the sea or larger lakes, the condition of background and changes and the extent of diffuse pollution due to intensive agriculture. Sampling is conducted, depending on the objective, 6 to 12 (24) times a year. Within the framework of the river hydrochemical monitoring, water samples are tested for quality indicators as well as biological oxygen demand (BHT_7), permanganate oxygen demand (PHT) or water chemical oxygen demand (COD) (TÜ Eesti Mereinstituut, 2012).

The content of organic substance in seawater (Estonian coastal sea) has been detected using distant monitoring methods. Although development of algorithms suitable for the Baltic Sea is in progress, it is possible to see the spatial pattern of organic substance (yellow substance) and its temporal variability based on archived raw pictures of the satellites MODIS and MERIS taken on cloud-free days and on the final product maps. Although yellow substance is generated in oceans during phytoplankton decomposition, its presence in the coastal sea is mainly related to an inflow from land. This is why the concentrations of the yellow substance are great in rivers` influence areas, for example in Pärnu Bay and the delta of River Neeva (TÜ Eesti Mereinstituut, 2012). In the Baltic Sea, a good correlation between the yellow substance and contents of organic substance has been observed (Kowalczuk *et al*., 2010). Therefore, distance monitoring has a great potential in assessing the content of dissolved organic substance in seawater and introduction of this methodology to monitor and assess the condition of the coastal sea should be considered in future.

The load of organic substance can also be assessed by the content of organic substance in sea sediments, which is a much more stable indicator than the content of organic substance in seawater. Potentially, it is possible to assess the amount of organic substance discharges in a region based on the content of organic substance sediments, but this indicator has not yet been included into the monitoring programmes. According to studies conducted for research purpose, in most gaps, larger contents of organic substance has been found. The contents of organic substance are also great in Tallinn Bay, Paldiski Bay, Haapsalu Bay and in the north-eastern part of the Gulf of Riga. The condition of these researched areas, based on organic substance, can be clearly considered non-satisfactory (TÜ Eesti Mereinstituut, 2012). In most other Estonian coastal waters, the condition of the marine environment can be assessed as satisfactory based on organic substance content. Only some researched areas, mostly in western Estonia, where the average organic substance contents of sediments is below 2% can be given a good score based on this indicator. As changes in the organic substance content is not measured within the framework of marine environment monitoring, the trends of this indicator are unknown (TÜ Eesti Mereinstituut, 2012).

The impact of organic pollution on marine biota has been assessed by comparing the abundance of species and cumulative curves of biomass (Weston, 1990; Kotta & Kotta, 1997). Occurrence of oxygen deficit in deeper sea areas causes shifting of the biota range maximums towards shallower marine areas (Kotta *et al*., 2008).

The condition of the Estonian coastal waters based on the input of organic substance and contents of organic substance is not good in most areas. Hence, it is necessary to limit not only inputs of nutrients but also organic substance into the coastal sea. It is also reasonable to improve monitoring to enable more precise detection of organic substance.

2.2.5 Introduction of microbial pathogens to waterbodies

The microbiological quality of the Estonian coastal water is influenced by point pollution sources (effluent inputs and stormwater outlets), diffuse pollution (washed and stormwaters from land) and faecal pollution from ships (inputs of untreated or partly treated sewage to the sea, pollution from ports).

In Estonia, there are altogether 42 urban communities with pollution load over 2,000 human equivalents (ie). There are 22 urban communities with human equivalents of 2,000−10,000 and 20 with over 10,000 human equivalents, of which adjacent to the sea are Tallinn, Kohtla-Järve, Pärnu, Narva, Kuressaare, Maardu, Sillamäe, and Haapsalu. About 900,000 people live in these 42 urban communities, where 94% of residents use the public water supply service and 92% have connections to the public sewerage system. The number of residents that have access to the public water and sewerage system is largest in Tallinn. In Estonia, wastewater is treated in larger communities using either biological (level II treatment) or biological-chemical method (level III treatment). It is not allowed to treat wastewater solely by mechanical method (level I treatment) any more. 40% of wastewater that requires treatment is also produced in Tallinn (TÜ Eesti Mereinstituut, 2012).

The requirements for treatment of wastewater and directing effluent to a waterbody or ground and measures for supervision of fulfilment of the requirements have been set down by Regulation of the Government of the Republic of 29 November 2012 No. 99 "Requirements for treatment of wastewater and directing effluent and rainwater to receiving water body, the limits of effluent and rainwater pollution indicators and measures to supervise fulfilment of the requirements[1]" (RT I, 13.06.2013, 13). The pollution indicators of effluent directed to a waterbody must meet the limit values set down in Annex 1 of the Regulation.

Stormwater forms mainly on asphalt surfaces and comes from rain and melting water that gathers on roofs and ground drainage water. Pathogenic microorganisms may get into stormwater as part of water washed from streets and residential districts, especially from hospital territories. Contaminated stormwater flows must be treated before directing them to a receiving waterbody so that not to deteriorate its condition. Stormwater flows may be directed from a combined sewerage system during a rain in accordance with regulation No. 99 through overflows together with wastewater one to four at least.

Significant microbiological contamination originates from ports and ships. Tallinn is becoming a more popular passenger terminal and a stopover for cruise ships. Tallinn has become the second destination after St. Petersburg among the ports visited by cruise ships sailing on the Baltic Sea. Cruise ships that travel all over the world are usually in South America, Caribbean sea, Panama channel or Asia in winter, in the Mediterranean Sea in spring and recently more often in the Baltic Sea in summer. For example, ships of the operators of the world`s largest cruise ship corporation Carnival, such as P&O Princess Cruises, Costa Cruises, Cunard Line, Seabourn Cruises etc. ships, but also ships like Royal Caribbean International & Celebrity Cruises, Crystal Cruises, Regent Seven Seas, Norwegian Cruise Line that belongs to the Star Group and others have visited Tallinn ports from 2010. In 2010, the listed cruise ships visited Tallinn Port altogether 286 times. In 2010, altogether 7,723 ships, of which 287 were cruise ships and passenger ships, visited the ports that are part of AS Tallinna Sadam (Muuga Port, Paljassaare Port, Vanasadam, Paldiski South Port, Saaremaa Port). In 2010, the amount of wastewater received from ships was 9,465 m^3, which is a relatively small amount compared to the number of ships and passengers that had visited the ports (TÜ Eesti Mereinstituut, 2012).

Discharge of wastewater (effluent) from ships to sea is regulated by the Alaska convention that does not specify nitrogen, phosphorous and bacteria content in effluent. The requirements of the Alaska convention are not sufficient for the Baltic Sea.

The amount of wastewater that may include pathogenic microbes produced on ships depend on the number of people and days on sea. The largest amount of faecal wastewater with unknown microbe content is generated on large cruise ships. The regular passenger lines usually give faecal waters over to the port every day. Cruise ships that carry thousands of passengers spend usually a week or more on sea, which means that large amounts of sewage is produced on ships that have not been disposed of in Estonian ports and they are disposed of, after some treatment, by putting them directly into the sea, mainly into international waters (Hänninen & Sassi 2009). As not all cruise ships are equipped with a wastewater treatment system, and even on ships that have treatment systems, the elimination of nitrogen and phosphorous from the effluent dumped into sea is insufficient, if we take into account the size and condition of the Baltic Sea. As wastewater is not disinfected before dumping into the sea, it contains also a large amount of microorganisms, of which some may be pathogens (Hänninen & Sassi, 2009).

According to the port charges procedure of AS Tallinna Sadam that was established in 2012, up to 7 m^3 wastewater is received per one ship on account of the waste charge. Any amounts exceeding this amount are charged additionally for actual received amounts and in accordance with the price list of the relevant waste treatment company (Green Marine AS, Maxitrans OÜ, Rarn-Sells AS). The waste charge is paid per gross tonnage (GT) of a ship for every visit, whereas the waste charges are lowest for passenger ships (0,010 EUR per GT unit) and highest for cruise ships (0,022 EUR per GT unit; Port fees…). The main obstacle for international cruise ships to disposing of wastewater in ports have been non-compliant wastewater reception equipment and relatively high service charges.

Microbiological quality of coastal water. In 2006, a new Bathing Water Directive 2006/7/EC was adopted to ensure concordance with other Community legislation on water, primarily the directive establishing a framework for Community action in the field of water policy. Directive 76/160/EEC was repealed with effect from 31 December 2014 by the new directive 2006/7/EC. The Member States were to transpose the Directive to their national law by March 2008, but the Member States were given time for complete implementation until 2015. The new requirements change the assessment and supervision of bathing waters considerably. The new directive specifies new requirements on water quality, monitoring, classification and assessment and informing of people.

Until 2007 bathing water was tested for coliform bacteria and faecal coliform bacteria as microbiological indicators and physical-chemical indicators (pH, transparency and presence of mineral oils) in accordance with the Government of Republic Regulation of 25 July 2000 No. 247 "Health protection requirements for bathing beaches and bathing water" (RT I 2000, 64, 407). From 2008, only two microbiological indicators – enterococcus and *Escherichia coli* counts – are monitored in bathing water (in accordance with the Government of the Republic Regulation No. 74 "Requirements for bathing water and bathing areas[1]" of 3 April 2008 (RT I, 29.08.2011, 6). The quality of bathing water is checked during the bathing season from 1 June to 31 August in all public and in some non-official bathing areas.

Presence of pathogenic bacteria and count is not analysed during the routine bathing water monitoring. Additional analyses on pathogenic microbes are conducted, if necessary, if the count of the indicator bacteria exceeds significantly allowed limit concentrations. Effluent and coastal waters are not tested for the count of pathogenic bacteria or viruses (analyses are made in exceptional cases, by the request of the Environmental Board, if there is a threat to groundwater (TÜ Eesti Mereinstituut, 2012).

Consequently, the most significant source of pathogenic bacteria in Estonia is the fast-growing cruise ship operating sector and still insufficient organisation of wastewater (sewerage) treatment originating from cruise ships. As cruise ships discharge partly treated sewerage mainly into international waters, it does not have a direct impact on the microbiological quality of the Estonian coastal waters. As the bathing season in Estonia is relatively short, the sea temperature cool and usually healthy people go bathing, the microbiological load on waters is local and small and possible pathogens load unlikely (TÜ Eesti Mereinstituut, 2012).

2.2.6 Contamination by hazardous substances

An overview of the situation concerning hazardous substances and contamination by these substances in the Estonian marine areas has been given by O. Roots, M. Simm and E. Realo in the initial assessment of the Estonian marine areas status (TÜ Eesti Mereinstituut, 2012). It was found that the status of the Estonian marine areas in terms of hazardous substances could be assessed as good. Only some analyses for some substances exceed unofficial limits in fish, such as heavy metals (Cd, Pb), organotin compounds, hexachlorobenzene. Concentrations of several compounds (Hg, pesticides, PCB) were lower that the target value or the limit of the particular analytical determination of the used method.

The issue of radioactive substances is especially topical in the Baltic Sea region due to the Chernobyl nuclear plant disaster (1986) that turned the Baltic Sea into the most contaminated sea with artificial radioactive substances in the world. However, seawater and biota in the Estonian marine area were only slightly contaminated. During the next decades, the general status of the sea has improved. According to the continuous monitoring data, there is a clear decreasing trend of content of radioactive substances in seawater and biota and a decreasing trend of radiation doses of habitants from assessments (TÜ Eesti Mereinstituut, 2012).

HELCOM (2010b) has assessed the status of marine areas in terms of hazardous substances as a whole. The general assessments of the Gulf of Finland and the Gulf of Riga give predominantly the status “average” to these areas, but the score “poor” has also been given. A positive aspect is that the concentrations of most hazardous substances are declining in the Baltic Sea marine environment.

Estonian Marine Institute of Tartu University (2015) has come to the conclusion in the monitoring report on hazardous substances in the Estonian coastal sea that the content of hazardous substances in organisms is not usually in conflict with the main objective of EU norms regarding environmental quality, i.e. the content of hazardous substances must not significantly increase over time.

The content of hazardous substances and their substance groups tested in Estonian rivers that flow to the Baltic Sea fell in most cases under the analytical determination limits of the particular analyses methods or did not exceed established environmental quality limit values. The results of research into synthetic compounds and biologically active substances have shown relatively low concentrations, which usually are below the set danger levels. The best is known about the situation of heavy metals regarding non-synthetic hazardous substances and compounds. The Ministry of the Environment requested a study to be conducted in 2010 to research the presence of 52 hazardous substances in 19 water-monitoring stations (of these, 18 surface water bodies). In some researched locations cadmium, nickel and tin contents that exceeded determination limits were found (TÜ Eesti Mereinstituut, 2012).

Hazardous substances are deposited into the Baltic Sea also from the atmosphere. Emissions of dioxin as well as heavy metals to the atmosphere have significantly decreased in recent decades in the Baltic Sea region (TÜ Eesti Mereinstituut, 2012).

The status of the Estonian marine area in terms of hazardous substances is average and poor according to HELCOM (2010b) data. However, the contents of hazardous substances is not generally in conflict with the main objective of environmental quality specified in the EU norms – the contents of hazardous substances must not significantly increase over time . A positive indicator is that the concentrations of hazardous substances in the Baltic Sea marine environment are decreasing. A decreasing trend is also seen in the contents of radioactive substances, although the indicator has not yet dropped to the level before the Chernobyl nuclear power plant disaster.

2.2.7 Marine litter

Every year, millions of tons of waste find their way into the global sea. Marine litter has not been considered a very important topic in the context of the Baltic Sea, the reason being that there are no data on marine litter amounts in this region.

The project MARLIN (http://www.projectmarlin.eu/, 13.08.2015) that includes all regions adjacent to the Baltic Sea was launched in 2011 with the objective to give an initial and more specific overview about marine litter in the Baltic Sea region. During the project, the amount and contents of litter on the beaches of Sweden, Finland, Estonia and Latvia (altogether 23 beaches, both in cities and rural areas) were monitored and assessments were made about the total amounts of marine litter that reaches the Baltic. The project was conducted following the method developed during the UN Environmental Programme in 2009. The final report of the project was presented in 2013, which has been used as the source for the following summary.

The results of the projects showed that plastic accounts for a large part of litter (ca 62%) on beaches. Particular plastic products (e.g. caps, packages etc.) as well as partly decomposed and therefore unidentifiable pieces of plastic products have been found. Other marine litter materials are metal, glass etc. The most common type of litter found on the beaches is cigarette buts.

During the project, it was found that there was more litter on urban beaches than on rural beaches which is directly related to littering by beach-goers and litter ending up at beaches from city ditches, rainwater systems etc. Litter (e.g. ropes, fishing gear etc.) on rural area beaches is expectedly sea-based (shipping, water tourism etc.). It was concluded that 80% of litter that is carried to the sea is land-based (including litter carried by rivers, non-compliant waste management in households etc.) and 20% of litter is from sea-based sources. However, the amount of seabed litter in the Baltic Sea was twice as high as in the North Sea which was confirmed by surveys conducted in 2012. This may be the result of lack of strong surface currents and tidal water in the Baltic Sea, which is why litter from sea-based sources may not reach the coast but settle onto the seafloor.

A positive aspect is that in accordance with HELCOM requirements, the waste reception conditions have been improved in ports. Furthermore, in 2015, HELCOM prepared a regional marine litter action plan that focuses on the possibilities of reducing marine litter.

As the largest part of marine litter is generated on land and it can be presumed that using plastic (including packaging) continues to increase in future, it is important to focus on improving the awareness of people about marine litter and compliant handling of waste.

2.2.8 Oil pollution from ships and its impact

Waterborne traffic in the Estonian marine areas is intensive. Traffic is especially intensive on the Gulf of Finland that is formed by the west-east transit traffic on the open sea of the Baltic Sea and on the Gulf of Finland. About 40,000 ships that have an AIS transponder enter and leave the Gulf of Finland annually. About 10,000 ships go through the Irbe strait that connects the Gulf of Riga to the open sea every year (HELCOM, 2014). The number of ships that sail through Väinameri is significantly smaller – about three hundred ships (Ramboll Eesti AS, 2007). In this region, more important is recreational craft traffic, and according to Ramboll Eesti AS (2007) estimated 1,500–2,000 recreational craft enter Väinameri in a year.

There is a high risk of ship accidents on the marine areas with intensive traffic. The most frequent reason of accidents is the so-called human factor, e.g. in 2013, people played a role in half of ship accidents that happened on the Baltic Sea and ended in pollution (HELCOM 2014). The accidents on the Baltic Sea during 2004–2013 were mostly related to collusions and running aground of ship. However, almost half of accidents are related to cargo vessels and in ca 5% cases pollution has ensued. In 1997–2006, 42 ship collisions happened on the Gulf of Finland (Kujala *et al*., 2013), which is four such accidents in a year on an average. Most of known collusion incidents occurred due to ice conditions. The largest collision risk area near the Estonian marine area is the region between Tallinn and Helsinki where intercity passenger ship traffic meets the east-west route of cargo vessels and tankers (Kujala *et al*., 2013). In the Estonian marine areas, the region with the most frequent accidents with tankers is the neighbouring area of Tallinn and Muuga (HELCOM, 2014).

In the "Emergency risk analysis – extensive coastal pollution" conducted by Environmental Board in 2013, the following conclusion was made: "Due to the fact that during the past 15 years three coastal pollution incidents that qualify as accidents have happened and taking into account that Estonia`s capacity to prevent or eliminate marine pollution does not meet yet HELCOM suggestions (in addition to insufficient pollution control capacity, an important factor is weather that does not often allow to perform operations on the sea), in most cases marine pollution causes also coastal pollution. Hence, the probability of coastal pollution can be assessed as high as the probability of an extensive marine pollution. Consequently, the highest environmental pollution risk in our marine areas is the risk of leakage of oil products into the sea due to ship accidents.

In addition to oil products that leak into the sea due to accidents, many smaller oil spills are found in the Baltic Sea every year. These spills are small individually, because they are usually smaller than 1 m^3, but altogether they are an important pressure on the Baltic Sea environment. The sources of pollution are usually leaking wrecks and ships travelling on the Baltic Sea that intentionally or unintentionally leak/dump oil products (e.g. polluted bilge water) into the sea. During the past two decades, the number of oil spills detected in the sea has been decreasing, regardless of the fact that the length of monitoring flights has increased as has the traffic load on the Baltic Sea. In the first half of the 1990s, about 400–600 oil spills per 3,000 flight hours were discovered in the Baltic Sea in a year. In 2013, 130 oil spills (of which 18 originated from the same wreck) were detected during 4,317 flight hours. The dynamics of oil spill detection is well described by PF (Pollution per Flight) index that shows the number of detected spills per a flight hour (HELCOM, 2014b, Figure 2.14). In the analysis of the HELCOM project BRISK it was found that the impact of various measures (double-bottom tankers, various navigational aids) reduce significantly the risks that come from the growth of waterborne traffic (Admiral Danish Fleet HQ, National Operations, Maritime Environment, 2011).

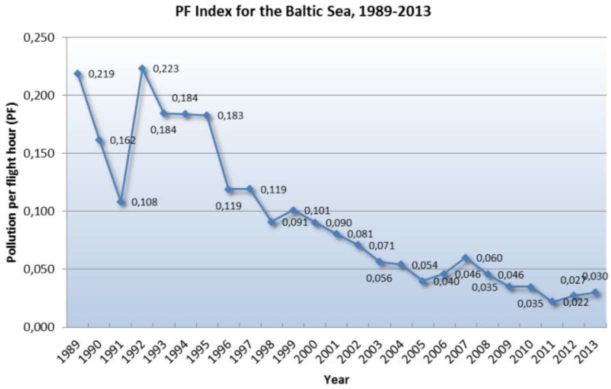

Figure 2.14. PF index or detected oil spills per a flight hour in the Baltic Sea, 1989–2013 (HELCOM, 2014b).

Oil pollution is one of the most dangerous pressures on a marine habitat that has direct and indirect impacts. Heavy highly viscous diesel fuels smear marine animals, enter their respiratory ways and digestive tract and disturb the most important vital functions. Marine organisms may die due to choking and/or disturbance of thermoregulation (ITOPF, 23.09.15). Birds are the most sensitive marine organisms to oil pollution and in marine pollution incidents they usually die in large numbers. The greatest impact occurs when plumage smears because petrol oil causes decomposition of the fat layer that protects feathers and the bird`s body from cooling down which causes disturbances of thermoregulation. The birds´ feathers sticks together and become wet, water gets into contact of the body, the body looses warmth and the bird dies because of hyperthermia. Furthermore, birds may swallow oil when cleaning their feathers, which in turn may cause serious health issues (ITOPF, 2011). Fish that can swim actively are able to avoid pollution and the cases of their massive dying because of pollution are very infrequent (ITOPF, 2011). More sensitive to oil and its products are fish spawns and juvenile fish.

In benthic communities, pollution may cause a decrease in biomass and abundance of the key species or their replacing with other species, which functions are different from the former species, and thereby cause changes in the dynamics of benthic communities. The condition of habitats may decline as a result of oil pollution and its clean-up, or they may even be lost, which restoration may take 1–5 years (ITOPF, 2011). Organisms are influenced due to damaged habitats that are an important source of food, and provide cover and suitable living conditions.

The impact of oil and its products, especially their light components on the marine organisms is in their toxicity. Chemicals enter organs, tissues and cells and they may cause sublethal and lethal effect (ITOPF, 23.09.15). Chemicals accumulated in an organism may cause animal reproduction failures and deformities of organisms. Pollutants move through the food chain to top organisms (birds, seals, people).

The impact caused by pollution may be much more extensive if an accident occurs in a protected area or if oil or its products find their way to its territory from other areas. The reason is that usually several valuable natural objects with high representation in the territory are in the same area.

There have been several ship accidents in Estonia that caused leakage of several tons of oil and its products into the sea, although most of them did not cause serious environmental problems. The largest environmental pollution happened at the end of January 2006 on the north-western coast of Estonia and the person that caused it has remained unidentified. During the clean-up operations, 10 tons of heavy fuel oil was collected but the amount that was leaked into the sea is not exactly known. Because of this pollution incident, thousands of birds died in north-western Estonia (Eesti Looduse Fond, 2007). No significant negative impact to benthic communities was found (Herküll & Kotta, 2012).

Due to intensive waterborne traffic and significant and extensive impact of oil pollution on the marine environment, oil products leaked into the sea due to ship accidents is the largest environmental pollution risk in our marine area.

2.2.9 Selective extraction of species

The summary has been compiled based on the overview prepared by A. Albert and H. Ojaveer included in the "Initial Assessment of Environmental Status of the Estonian marine area" (2012). The catch volumes are described in chapter 2.3.1.

Commercial fishing in the Estonian waters takes the form of either deep-sea fishing or coastal fishing. The sprat and the Baltic herring that are caught by trawls are the target species on the open sea. The main co-catch species is the European smelt, sometimes also the salmon and the sea trout. Other co-catch species are the sticklebacks, the eelpout and the scorpion fish.

In the coastal sea, the main gear used is entangling nets and traps that are classified as passive gear. The largest numbers of the Baltic herring are fished during coastal fishing activities. In the Gulf of Finland, flounders, perches, whitefishs, European smelts, sea trouts and garfish are caught in addition to the Baltic herring. The cod (0.1 t in 2007; 2.1 t in 2010; 3.3 t in 2014) and a non-native species Atlantic gobies (0.1 t in 2007; 1.1 t in 2010; 11.2 t in 2014) catches have increased in the region (Maaeluministeerium, 2015).

The most caught fish species in the Gulf of Riga are the Baltic herring, the perch, the garfish, the roach, the flounder, the goldfish, the vimba bream, the pike, the whitefish, the European smelt and the European eel. On the western coast of Saaremaa and Hiiumaa, the flounder is the most caught species. The Baltic herring, the roach, the perch, the sea trout, the ide, the whitefish and the pike are also harvested. In this region, the cod is also caught in small amounts. The most caught fish in Väinameri is the Baltic herring, followed by the garfish, the perch, the goldfish, the roach, the flounder, the pike etc.

The largest catches of recreational fishing are caught by entangling nets, but the catches are much smaller compared to commercial fishing. Longlines, hooks and spinning are also used for fishing. The most caught species by recreational fishing are the flounder and the perch. The salmon, the sea trout, the whitefish and the round goby official recreational catches are comparable to commercial fishing.

When passive gear (entangling nets, traps) is used, co-catch includes both undersized target and non-target species or individuals that have just reached maturity. Seals and birds, especially diving ducks, entangle in fishing nets. Most vulnerable are birds during their migration and wintering period when they gather into flocks in intensive fishing areas. Based on data collected in 2005–2008 by fishermen, about 5,000 birds died in the Gulf of Finland annually, of which 78% are long-tailed ducks (Žydelis *et al.*, 2009).

The largest number of seals die in traps in areas with high fishing pressure (Vetemaa & Piirsalu, 2011). Of marine mammals, harbour porpoises may be in Estonian waters, although according to the existing data, no harbour porpoises were caught in fishing gear in 2004–2010 (Sirp & Klaas, 2011).

For many fish species, the fishing mortality rate is very high. Birds and marine mammals also die due to fishing activities. Selective catching of species is an important pressure on the marine environment.

2.2.10 Introduction of non-indigenous species

Non-indigenous species are species that have spread to habitats with the help of people whereto due to natural obstacles they cannot spread themselves and that are able to live and reproduce in the new environment. Non-indigenous species can invade a sea by many different ways, such as floating vessels, aquaculture, fishing, recreation, waterways and aquarium and live fish trade. Introduction of non-indigenous species into the ocean and especially into the coastal sea may cause serious impacts on the environment, economy and human health (e.g. cholera bacteria). In 2012, 118 non-indigenous species were found in the Baltic Sea, of which 90 is estimated to have been introduced to the marine ecosystem. The number of non-indigenous species in the southern coast of the Gulf of Finland, in the Estonian coastal sea, was 26, and 14–17 in the western coastal sea (Figure 2.15) (Ojaveer *et al.*, 2011; Rolke *et al.*, 2013).

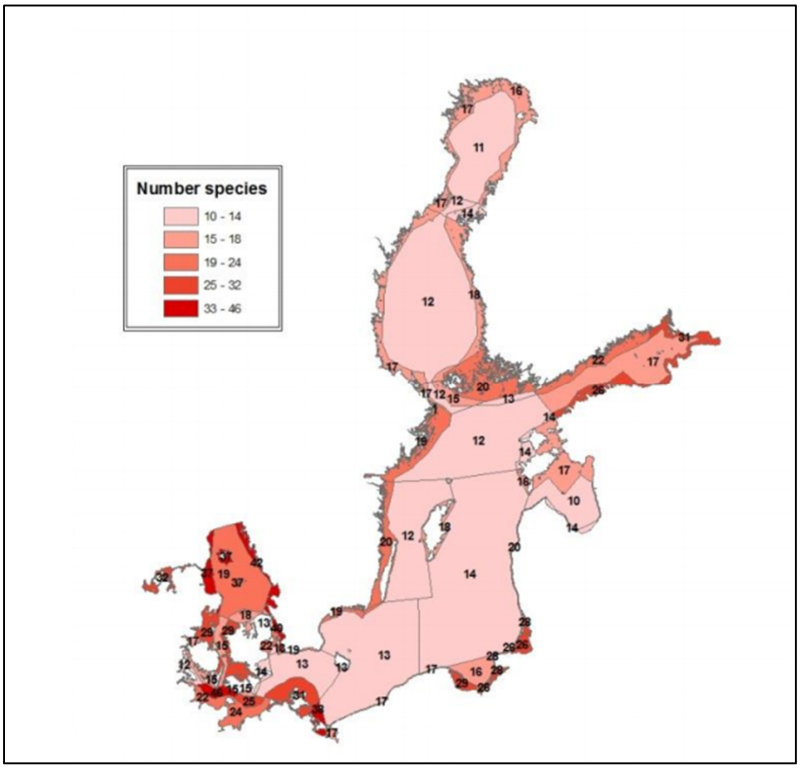

Figure 2.15. The total number of non-indigenous species in the coastal and offshore Baltic Sea in 2012. (Rolke *et al.*, 2013).

In the Baltic Sea, shipping poses the greatest invasion risk. The ballast water of ships plays the primary role in introducing non-indigenous species. Invasive species may spread also by attaching themselves to ship hulls. In recent decades, waterborne traffic on the Baltic Sea has intensified, therefore the invasion risk of non-indigenous species has grown. An important role in the introduction of non-indigenous species are cargo vessels, which percentage in marine transport is about 50% according to HELCOM (2010) report. The largest primary invasion risk area in Estonia is the Tallinn region (primarily Muuga Bay) where is one of the largest Baltic Sea ports. Another important invasion route goes along waterways. In the Baltic Sea context notice worthy are the waterways that link different river systems (TÜ Eesti Mereinstituut, 2012).

The impact spectrum of non-indigenous species is wide. They may influence nature at the level of gene, species, community, biotope and ecosystem. Non-indigenous species may through habitat and food competition change reproduction and growth speed of local species, their range and location and abundance in populations. They may also cause changes in the biodiversity of benthos, thereby influence also food webs and change the condition of habitats causing their siltation, accumulation of bottom sediments, overgrowing etc. Non-indigenous species may also be parasites and infectious agents (Ojaveer *et al.*, 2011).

Shipping is the most important entryway for non-indigenous species through ship ballast water and by attaching to ship hulls in the Baltic Sea.

2.2.11 Intentional or systematic release of solid substances into the marine environment

H. Ojaveer has made an overview of systematic introduction of solid substances into the environment in the report prepared about the Estonian marine areas status in 2012 (TÜ Eesti Mereinstituut, 2012). The overview is referenced below.

When discussing the topic of systematic introduction of solid substances into the environment, three different human activities must be taken into account.

Although disposal into the sea of garbage from ships is not permitted, food wastes may be discharged into the sea within 12 nautical miles from the nearest land. This has been specified in the ***International Convention for the Prevention of Pollution by Ships*** MARPOL 73/78. The convention was adopted in 1973 and supplemented with a protocol in 1978. Estonia joined MARPOL 73/78 Convention in 1992 and its Annexes I–V in 2007. There is no published data about the specific nature and volumes of the relevant garbage regarding Estonia and the Baltic Sea.

Another important topic because of its scope and influence is related to port facilities and energy carriers. The development of port facilities on the coast includes dredging and widening of the channel but also activities that are related to the construction and extension of quays. We have described these activities in the physical damage section (2.2.1).

Recently, installation of different energy carriers (cables, pipes) and/or energy generators (wind turbines) in the sea has intensified which means that during the construction works the bottom sediments may be relocated and the base of the energy carriers may be filled up with suitable construction material. Depending on the energy carrier, such operations may be performed in the coastal sea as well as deeper high seas. Windfarms are planned to be erected in the coastal sea of north-western Estonia. To install wind generators in the sea, a basement must be constructed first. Generally, there are three basement types: concrete gravity foundation, steal pile foundation and steal tripod. Construction of concrete gravity foundation (area 175 m^2 and mass 1,000 tons) requires extensive construction works that entail elimination of mud and flattening of sea bottom. In any case, an electric cable has to be installed onto the sea bottom regardless of the foundation type. During these operations, sea sediments are relocated (Hendrikson & Ko OÜ, 2011). This all means a significant impact on the region and possibly major relocation of sea sediments and using of concrete to build the foundation (Järvik, 2011). When using gravity foundation, the foundation is placed onto the sea bottom and the direct impact on the habitat is caused by sealing off the area which size is equal to the cross-sectional area of the foundation. In this case the sea bottom is not physically damaged (OÜ Alkranel *et al*., 2015).

No known data has been published on the amount and nature of food wastes. A potential significant impact on the character of sea bottom may be caused by erecting wind generators.

2.2.12 Status of the natural environment

To describe the status of the marine environment, we use qualitative descriptors to determine good environmental status (Annex I of the Marine Strategy Framework Directive):

1. Biological diversity is maintained. The quality and occurrence of habitats and the distribution and abundance of species are in line with prevailing physiographic, geographic and climatic conditions.

2. Non-indigenous species introduced by human activities are at levels that do not adversely alter the ecosystems.
3. Populations of all commercially exploited fish and shellfish are within safe biological limits, exhibiting a population age and size distribution that is indicative of a healthy stock.
4. All elements of the marine food webs, to the extent that they are known, occur at normal abundance and diversity and levels capable of ensuring the long-term abundance of the species and the retention of their full reproductive capacity.
5. Human-induced eutrophication is minimised, especially adverse effects thereof, such as losses in biodiversity, ecosystem degradation, harmful algae blooms and oxygen deficiency in bottom waters.
6. Sea-floor integrity is at a level that ensures that the structure and functions of the ecosystems are safeguarded and benthic ecosystems, in particular, are not adversely affected.
7. Permanent alteration of hydrographical conditions does not adversely affect marine ecosystems.
8. Concentrations contaminants are at levels not giving rise to pollution effects.
9. Contaminants in fish and other seafood for human consumption do not exceed levels established by Community legislation or other relevant standards.
10. Properties and quantities of marine litter do not cause harm to the coastal and marine environment.
11. Introduction of energy, including underwater noise, is at levels that do not adversely affect the marine environment.

Each descriptor has a set of indicators that show whether GES has been achieved according to the relevant indicator. Indicators of good environmental status by descriptors are presented in the work “The set of Estonian marine area good environmental status indicators and environmental targets” (TÜ Eesti Mereinstituut, 2012b). In Estonia, the marine monitoring programme was prepared in 2014, during which suggestions were made for updating good environmental status indicators and environmental targets established in 2012.

For the first descriptor, good environmental status has been achieved according to 20 indicators and eight indicators need improving. Good environmental status has not been achieved for the following indicators:

- The ringed seal range;
- The ringed seal distribution type;
- Predatory fish abundance index in monitoring catches.

According to one indicator (percentage of non-indigenous species in the community of large demersal invertebrates) of the second descriptor, GES has been achieved. GES has not been achieved for the following indicators:

- Abundance of pelagic non-indigenous invertebrates;
- Biomass of non-indigenous large demersal invertebrate species;
- Percentage of non-indigenous species in the biomass of zooplankton community;
- Level of biocontamination.

According to one indicator (the length of perch (*Perca fluviatilis*) upon reaching maturity) of the third descriptor, GES has been achieved. GES has not been achieved according to the following indicators:

- The Baltic herring (*Clupea harengus membras*) fishing mortality rate;
- The sprat (*Sprattus sprattus balticus*) fishing mortality rate;
- Yield index of non-indigenous species in monitoring net catches;
- Smolt (*Salmo salar*) abundance compared to the maximum natural potential abundance;
- Abundance index of mature perch (*Perca fluviatilis*) in monitoring catches;
- Abundance index of large perch (*Perca fluviatilis*; TL > 250 mm) in monitoring catches;
- The perch (*Perca fluviatilis*) sizes 95% percentile in monitoring catches.

According to two indicators (average maximum length of all fish species in monitoring catches and trophicity index of fish communities) of the fourth descriptor, GES has been achieved and one indicator requires improving. GES has not been achieved for the following indicators:

- Abundance of smolt (*Salmo salar*) compared to maximum potential natural abundance;
- Abundance index of large perch (*Perca fluviatilis*; TL>250 mm) in monitoring catches;
- Ratio of maxillopodans biomass to the biomass of all mesozooplankton;
- Abundance index of predatory fish in monitoring catches.

According to four indicators of the fifth descriptor, GES has been achieved and two indicators require improving. GES has not been achieved according to the following indicators:

- Total nitrogen concentration in seawater in summer;
- Total phosphorous concentration in seawater in summer;
- Content of chlorophyll a in seawater in summer;
- Phytoplankton biomass in summer;
- Transparency of seawater in summer according to the Secchi disk.

According to four indicators of the sixth descriptor, GES has been achieved and four indicators require improving. GES has been achieved according to most indicators of the eight and ninth descriptors. Figure 2.16 gives a summary of achieving GES by GES descriptors and indicators of the MSFD in the Estonian marine area. The results of the inventory of the indicators show clearly that there is a need to develop the monitoring efforts and work out indicators for descriptor 7 (Effect of permanent alteration of hydrographical conditions), 10 (Marine litter) and 11 (Energy and noise). The expert group was unable to present immediately usable indicators for these descriptors. Assessments were not given due to insufficient data as well as lack of indicators that could be used for the Estonian marine area.

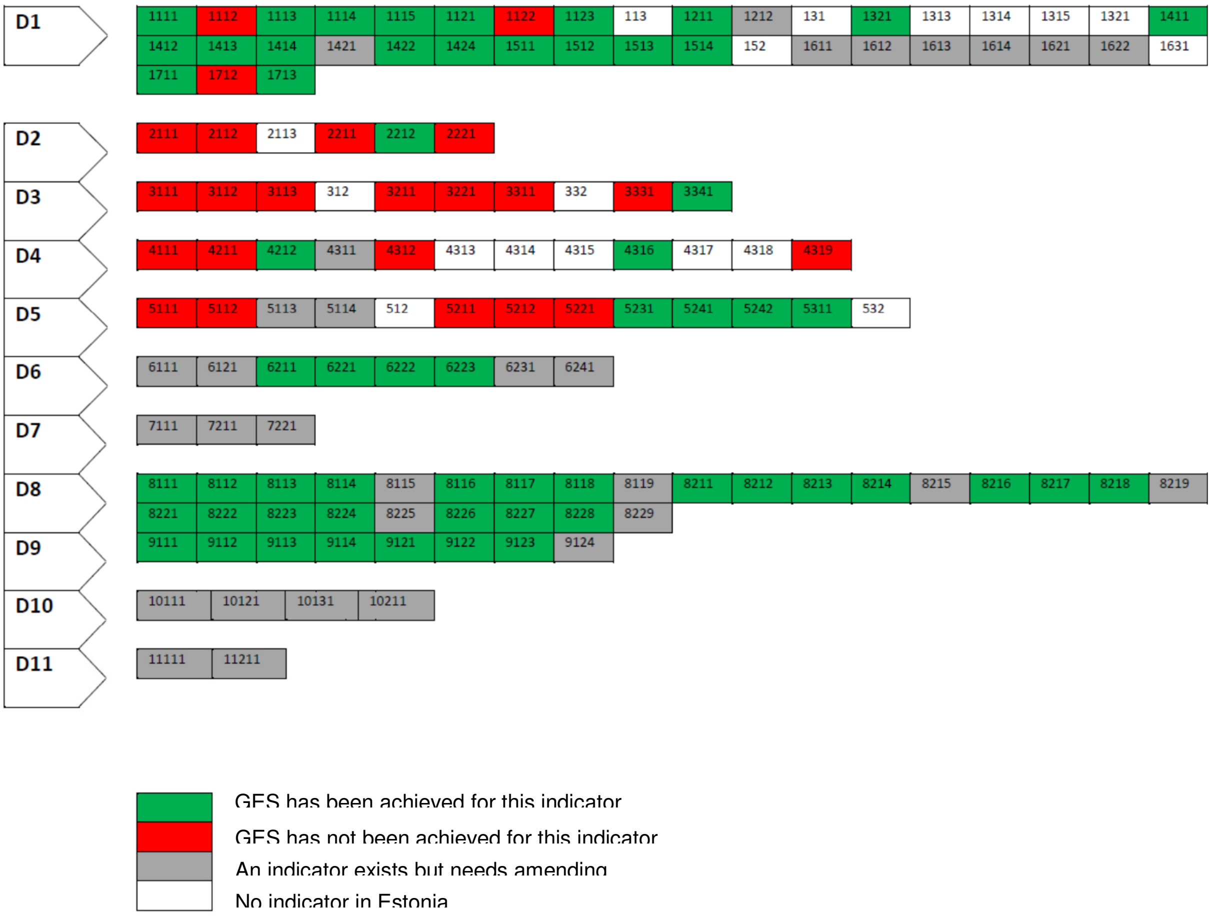

Figure 2.16. Achieving of GES by MSFD descriptors and indicators in the Estonian marine area. The indicator codes match the codes used in the indicator document sheets included in the annex of the report (TÜ Eesti Mereinstituut, 2012b).

Good environmental status of the natural environment of the Estonian marine areas has been achieved only by few descriptors. For five descriptors, at least three indicators show that good environmental status has not been achieved. For three descriptors, there does not exist any indicators applicable for the Estonian marine areas.

2.3 Overview of socio-economic environment and problems

2.3.1 Maritime industry related business environment

For the purpose of this SEA report, the business environment includes various infrastructures (electricity, gas) and related business as well as the development of shipping, fishing, aquaculture, tourism and energy in the Baltic Sea area.

The maritime industry plays an important role in the Estonian economy, because *ca* 60% of Estonian export and import operations are conducted by sea. Access to sea and location enables Estonia to earn an important income from international carriage of goods, tourism and fishing (Eesti merenduspoliitika 2012–2020, 2011).

The cluster study of maritime industry shows that the sales revenue of maritime companies has gradually grown in 2004–2010 (Figure 2.17, TTÜ Eesti Mereakadeemia, 2015).

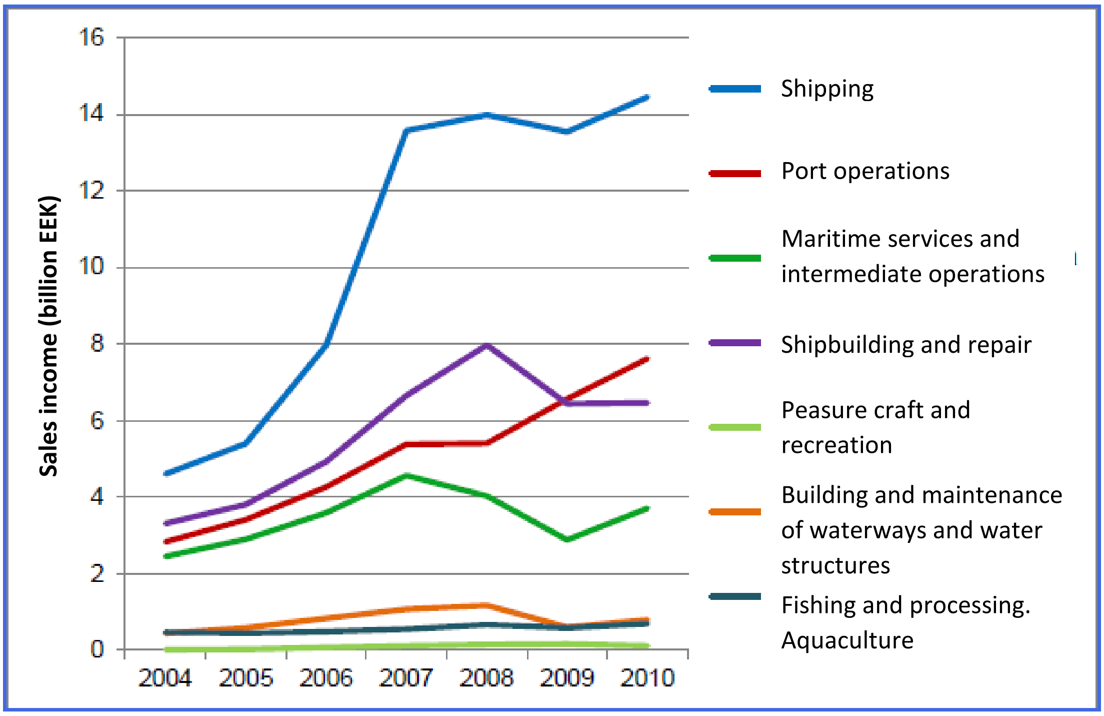

Figure 2.17. Sales revenue of Estonian maritime cluster in comparison to subclusters in 2004–2010 (TTÜ Eesti Mereakadeemia, 2015).

<u>Infrastructure</u>

Direct current connections with Finland (EstLink 1 and EstLink 2) have been established. In a longer perspective, it is possible to create a connection with Sweden and construct a third connection between Estonia and Finland that would ensure sale possibilities for the production of perspective offshore windfarms. In following years, a new alternating current high voltage connection with Latvia will be added, and, in a longer perspective, it is possible to make a connection with Latvia by a sea cable. Synchronisation of the **power grids** of the Baltic States and the European Union is planned. As Estonia intends to join the synchronous area of Central Europe, grid connection with Russia must be better controlled. This requires converter stations to be built on the state border (National Spatial Plan "*Estonia 2030+*").

Transition to **natural gas** as the most clean fossil fuel requires the development of necessary infrastructure, i.e. liquefied gas (hereinafter LNG) terminals and bunkering stations in the SECA region, including the Baltic Sea ports. Currently, the number of LNG terminals is limited, the only terminals are near Stockholm and Klaipeda. Two LNG terminals are being planned to be built in Estonia in near future – in Paldiski on Pakri Penninsula and in Muuga Port. The plan is to connect Estonian gas transfer network in addition to the existing transfer networks to the Finnish gas market via Balticconnector (Figure 2.18). According to the programme of the environmental impacts assessment (2014) of the Balticconnector project, connecting Estonian and Finnish gas markets would create a more uniform and diverse natural gas network in the Baltic Sea region in future and thereby improve the security of natural gas supply for the Member States in the north-eastern part of the European Community. Open sea gas pipe would enable exchange of natural gas between Finland and Estonia and at the same time offers an opportunity to use Latvian underground gas storage facilities. The planned gas pipe could operate in both ways, enabling transfer of gas through Finland to Estonia and vice versa (Ramboll Eesti AS, 2014).

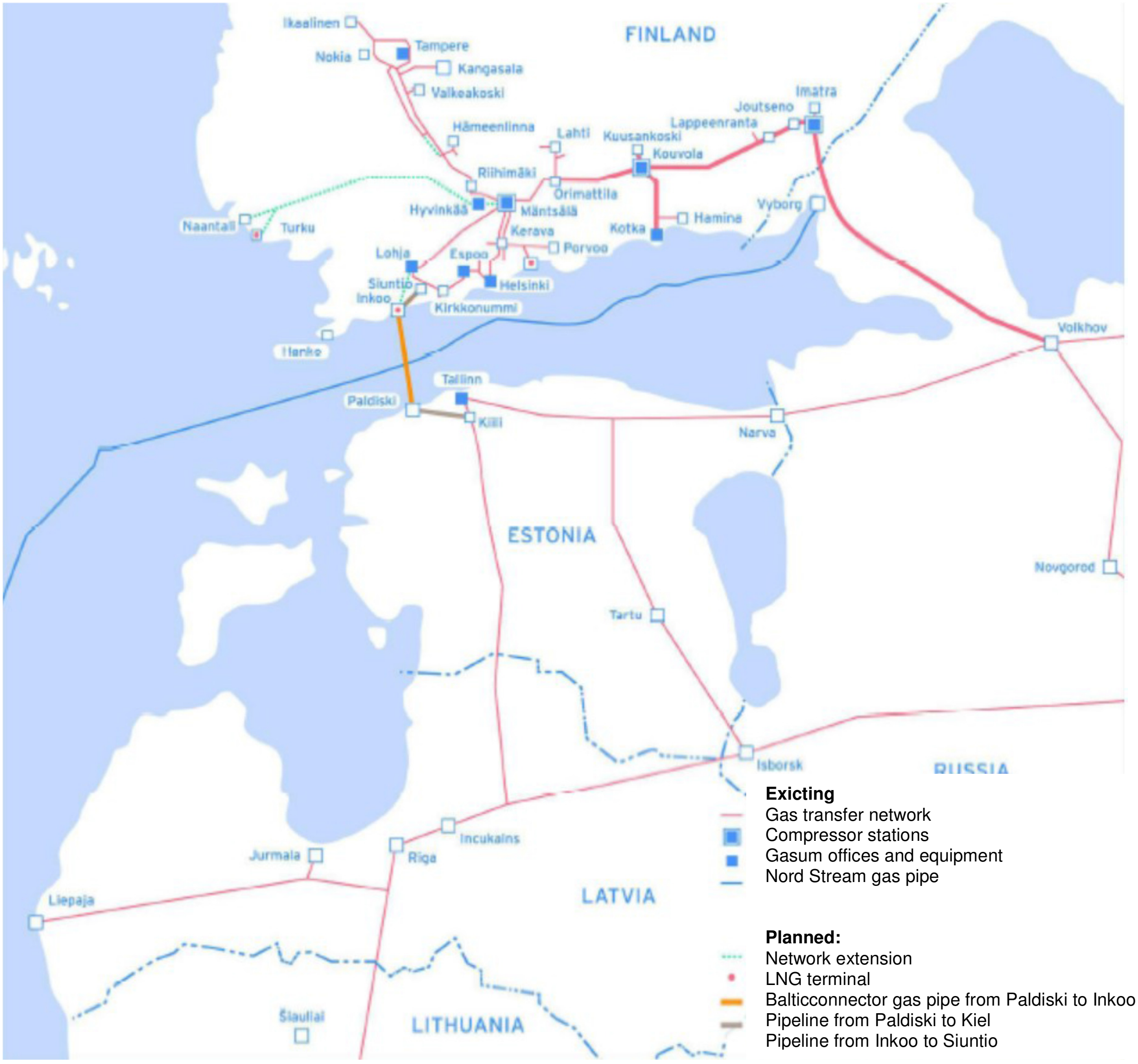

Figure 2.18. Gas pipes in the Gulf of Finland region (existing and planned) (Ramboll Eesti AS, 2014).

Main problems of a LNG terminal construction in Estonia:

- insufficient awareness work about the advantages and disadvantages of LNG use;
- no legislation that regulates LNG operations (including bunkering);
- excise policy that does not promote using of natural gas as fuel;
- no support measures to facilitate using LNG on ships;
- relatively small investing capacity of ship owners;
- lack of experience in using LNG ship fuel.

Offshore windfarms are described in more detail in section 2.3.3.

Marine infrastructure problems are mainly related to intensifying construction of infrastructures into the sea where clearly is seen a relative growth of physical loss: smothering of seafloor, sealing and growth of underwater noise due to construction works.

Shipping industry

The annual overview of the ship register prepared by the Estonian Maritime Administration shows (Figure 2.19) a big drop in the number and gross tonnage of bareboat charted cargo vessels, because in 2002 the Estonian ship register included entries about 21 ships with the total gross tonnage of 121,034. By 2015, there was left not one bareboat chartered cargo vessel under the Estonian flag.

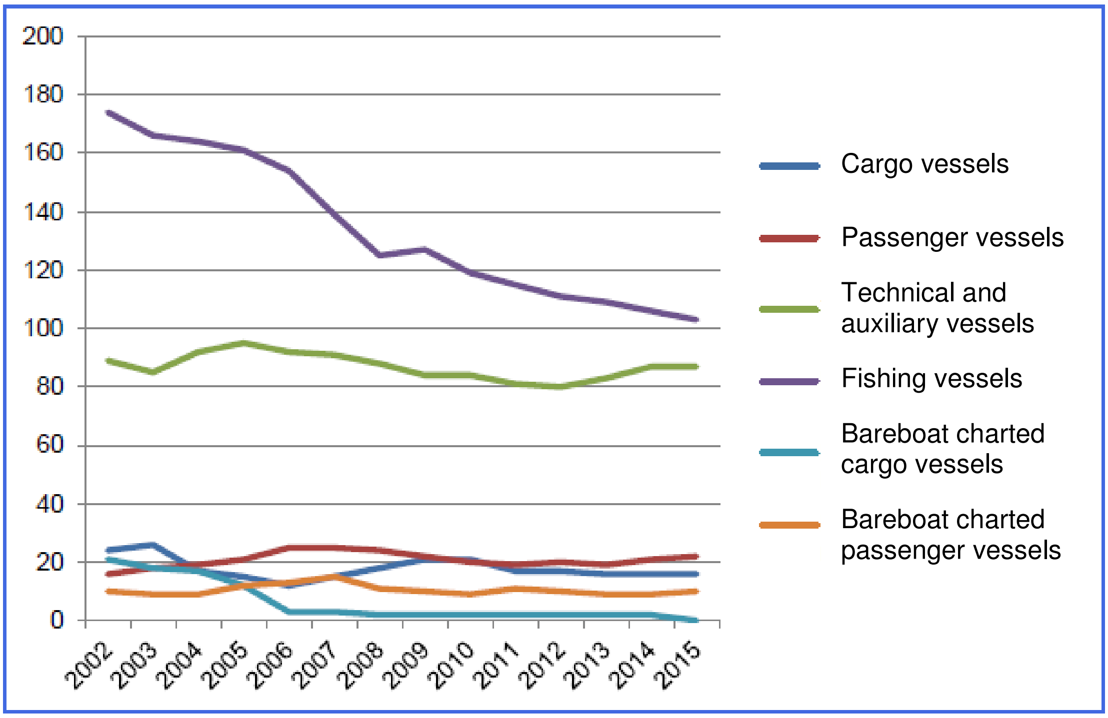

Figure 2.19. Number of seagoing craft in 2002–2015 according to the Estonian ship register (prepared based on the Estonian ship register data of the Estonian Maritime Administration, 2015)

In addition to changes in the number of bareboat cargo vessels, the number and tonnage of fishing ships has dropped almost by half (Figure 2.19): when in 2002, there were 174 ships with 31,122 GT, the number of fishing ships has dropped to 103 with 17,631 GT by 2015. The smaller numbers and gross tonnage of fishing vessels is mainly due to balancing catching capacity with fishing opportunities because the number of fishing vessels in Estonia was too big and inefficient for the existing fishing opportunities. Matching catching capacity with fishing opportunities was supported with the financial resources of the European Fisheries Fund.

The number of passenger ships that sail under the Estonian flag has been quite stable compared to the 2003 data. The gross tonnage has increased two and half times because old ships have been replaced, for the most part, with new ships. However, two new passenger ships do not sail under the Estonian flag any more.

From 1 January 2015, all ships that sail in the Baltic Sea must use fuels with sulphur content < 0.1% or must be equipped with treatment facilities that ensure SO_x content reduction to the required limit in exhaust gases. Currently, only a few LNG fuel ships sail on the Baltic Sea. Tallink as well as the Swedish company Rederi AB Gotland have made or intend to make contracts for the construction of one new ship that uses LNG as fuel. AS Tallinna Sadama has also contracted the building of four new LNG-ready (allowing transition to LNG fuel) passenger ferries for the shipping lines that connect Saaremaa and Hiiumaa.

However, a very quick growth in the number of LNG-ships is not foreseen in near future, because facilities for supplying ships with LNG in ports, except for in Norway, are non-existent or limited. For example, in the Baltic Sea region there are operating terminals only near Stockholm and in Klaipeda.

As Estonian shipping industry is part of the world and the Baltic Sea shipping industry, there are several influential factors and development barriers for shipping, of which the most important are listed below.

National development barriers of shipping are

- non-existent uniform and strong maritime cluster;
- low efficiency of targeted and systemic maritime policy implementation;
- insufficient cooperation of the public and private sectors in developing the maritime sector;
- low competitiveness of the Estonian ship register that does not motivate ship owners to bring ships under the Estonian flag.

Global competition affects shipping industry very strongly, because companies have the right to register their ships to the registers of other countries (choosing of flag state). Such ships operate as subsidiaries registered in another country that are applied the rights and obligations, taxes etc. of the flag state. The ship owners of countries with higher tax rates and more costly labour register their ships in the registers of flag of convenience states and recruit the crew from countries which citizens do not pay taxes to their country on the earned income. To reduce such unequal competitive impacts, the European Union allows its Member States to support local shipping industry by implementing various measures, of which most important are tax incentives.

It is important to provide Estonian shipping companies with equal competitive conditions at least with neighbouring countries. This means bringing into line of ship operating costs to those of competitors as well as improving administrative activities related to ship operating. The system should be established for a long term to ensure companies certainty so that they are ready to invest. The system must also take into account trawlers.

According to “*Maritime Sector Overview 2013*”, the common water charge came into effect on 1 July 2013 due to the amendment of the Maritime Safety Act that ensures more uniform principles to stay in competition with neighbouring countries.

Shipbuilding and repair

According to the commercial register, altogether 155 companies operated in the field of building ship and floating structures and repair of ships and boats in Estonia in 2010. However, there are only four large shipbuilding companies that employ most of the employees (Eesti merenduspoliitika 2012–2020, 2011).

As in case of ports, in shipbuilding we have to discuss separately recreational craft building where *ca* 30 small and medium-sized companies are involved that generate the total turnover of *ca* 140 million euro. These companies are usually based on local capital and build and develop ships as sub-contractors, but manufacture also their own products (yachts, small commercial boats, fishing boats, wooden boats etc.) and their products are mainly exported to Nordic countries and other European countries (Eesti merenduspoliitika 2012–2020, 2011).

There are three weaknesses that limit the development of the shipbuilding sector: lack of qualified labour, no infrastructure to build and repair large ships year around and limited investing capacity. The state can support entrepreneurs through cooperation that targets renovation of the state-owned fleet. As the competitive edge of Estonian companies lies mainly in building special and more complex ships, using technological updates and providing flexibility in fulfilling orders, they have to offer new and innovative solutions. However, entering the market with a new product is complicated, because potential buyers need certainty that these products function. During the renovation of the state`s fleet, it is possible to take into account the new solutions offered by our entrepreneurs that would give them an opportunity to demonstrate the operational reliability of their products and give a reference for potential foreign clients (Eesti merenduspoliitika 2012–2020, 2011).

Tourism

The main resource of the Estonian marine tourism is the nature that has not been influenced very much by human activity, offers varied landscapes, diversity of species and a long coastline with over 1,500 islands and inlets.

The main activities in developing marine tourism are

- an integral development of marine tourism products and services and linking them with other Nordic countries tourism routes;
- turning Tallinn into a starting and destination point of the Baltic Sea cruise ship routes and lengthening the stay time of cruise ships in Tallinn by developing necessary tourism products and services;
- extending international ship travel routes to other Estonian coastal areas and island (e.g. Kunda, Sillamäe, Saaremaa);
- promotion of awareness in neighbouring markets about marine tourism products and services offered on the Estonian coast and islands and about local recreational opportunities (Eesti riiklik turismiarengukava 2014–2020, 2013).

Marine tourism can be divided into two broad categories: passengers of international lines and cruise ships that come to Estonia mainly for destinations that are not related to the sea and recreational craft passengers that visit Estonia`s coast and small harbours for sightseeing and sea-related and coast-related activities. The importance of tourism in Estonian economy is not limited to the carriage services, but also includes money that tourists leave in Estonia to pay for products and services to accommodation, catering and other companies and retailers (Eesti merenduspoliitika 2012–2020, 2011).

The Baltic Sea cruises usually begin in England, Denmark, Sweden or Germany. According to Statistics Estonia, in 2011, 294 cruise ships carrying 436,181 passengers visited Estonia, which was a 11% growth compared to 2010 (Eesti merenduspoliitika 2012–2020, 2011). According to the *"Maritime Sector Overview 2013",* the number of international passengers that passed through Tallinn Port grew year-on-year by about 400,000 people or 4.5% in 2013 to the record high 9.2 million passengers. The number of cruise ship passengers grew to a record high 530,000 passengers.

The market of ship passengers from Finland, the main country of inbound tourism, is saturated and although the number of passengers has grown in recent years, the number of overnight stays is smaller than five years ago. After repeated visits, there are no attractions, products or services that would motivate potential visitors to come to Estonia again. The average stay period of foreign tourists is very short (two nights) and the portion of one-day-visitors is high, which is why income per a tourist is relatively low. This shows that there is a need to extend the selection of tourism services or improve promotional activities. There is still room for development on how to shape the image of Estonia as an attractive country of destination and break down negative prejudices (Eesti merenduspoliitika 2012–2020, 2011). AS Pärnu Sadam started to reconstruct the Pärnu city centre quay in 2015. Pärnu River is also dredged to develop capacity to receive cruise ships in Pärnu.

Recreational craft tourism has highest potential to increase the number of tourists visiting Estonia. In summer, about 200,000 yachts sail on the Baltic Sea and the total number of international visitors is estimated to be 2 million people (Eesti merenduspoliitika 2012–2020, 2011).

In the context of the Marine Policy, it is important to ensure the competitive edge of companies that are involved in carriage of passengers so that they are able to offer clients attractive price and good service. Currently, there are only 24 harbours in Estonia that offer services compliant with the relevant requirements. A weakness concerning recreational craft tourists is their lack of knowledge about the services offered in small harbours (Eesti merenduspoliitika 2012–2020, 2011).

In addition to tourism, the sea is also used for various recreational purposes – sporting and relaxing on the beach and on the sea. According to the Health Board, there were altogether 27 public bathing beaches in counties bordering the sea in 2011. Sailing is a sport that has a growing number of people involved in it in Estonia. The Estonian Yachting Union has 32 sailing organisation with the total of almost thousand members. People sail year around, in summer on yachts and sailboats and in winter on iceboats (TÜ Eesti Mereinstituut, 2012).

***According to the Estonian National Tourism Development Plan for 2014–2020* (2013), the routes of international shipping lines are overly concentrated around Tallinn and it is necessary to extend them to other coastal regions and islands (e.g. Kunda, Sillamäe, Saaremaa). In addition, to develop marine tourism, it is necessary to improve the**

awareness of neighbouring markets about the marine tourism products and services offered on the Estonian coast and islands and about the local recreational opportunities.

Fisheries

Fishing activities on the Baltic Sea are trawl fishing and coastal fishing. *The Fishing Act* allows coastal fishing up to 20 m isobath, except for the flounder fishing that is sometimes done up to 30 m deep sea in summer. According to the Government of the Republic Regulation No. 144 *Fishing Rules* of 9 May 2003, trawling is allowed only in the marine areas that are deeper than 20 meters.

A regulation of the European Commission specifies every year the fishing quota of the EU for the Member States on the Baltic Sea. The quota allocated to Estonia is divided between trawling companies on the historic fishing right. The national Baltic herring quota is allocated between trawl fishing and coastal fishing, 70% and 30%, respectively. Fishing is done in the fishing squares shown on Figure 2.20 (SA SEI Tallinn, 2012).

Figure 2.20. The Baltic Sea fishing regions (SA SEI Tallinn, 2012)**.**

According to the data of Statistics Estonia, deep-sea fishing on the Baltic Sea in 2000–2010 accounted for 75–90% of the total fishing activity on the Baltic Sea. The most caught species are the Baltic herring and the sprats and the portion of these fish in the total catch numbers exceeds 95%. In addition to the Baltic herring and the sprat, the perch, the cod and the flounder are caught from the Baltic Sea (altogether 14% of the catch). The proportion of other fish species in the catch is marginal. No significant changes have occurred in the absolute catch number – altogether 60,000 to 85,000 tons of different fish was caught from the Baltic Sea in 2000–2010 (SA SEI Tallinn, 2012). In 2012, 29 companies were active in Estonia in trawl fishing. As of the end of 2011, *ca* 215 employees worked on the Baltic Sea trawlers (Eesti kalanduse strateegia 2014–2020, 2013).

The main coastal fishing regions are Pärnu Bay, Väinameri and the Gulf of Finland. Many different species are caught, of which economically more important are the perch, the Baltic herring, the smelt, the zander, the flounder, and the eel. The garfish and the sea trout are also important species, the salmon and the pike are caught in smaller numbers (SA SEI Tallinn, 2012). As of 2011, there were 1,530 coastal fishermen and 247 fishermen that fish on coastal and inland waters (Eesti kalanduse strateegia 2014–2020, 2013).

The volume of recreational fishing compared to trawl fishing is marginal. In Estonia, there are many recreational fishermen: in 2010 about 292,000 people were involved in recreational fishing activities (270,000 – 317,000, Eesti kalanduse strateegia 2014–2020, 2013).

The main raw material of Estonian fish processing companies are local fish species, the Baltic herring and the sprat, and for the filleting companies fresh water fish, the perch and the pike-perch. In 2011, 22% of Estonian total production (fishing and aquaculture) of fish and fish products remained in the country for consumption and 78% was exported (Eesti kalanduse strateegia 2014–2020, 2013).

A very important pressure in the fisheries sector is selective extraction of species as well as input of organic matter into the sea. These topics have been discussed in detail in section 2.2.

A weakness of fisheries (e.g. in the Gulf of Riga) is high intensity of fishing, which main cause is a high limit number of fishing gear. It is necessary to find a balance between fishing opportunities and the existing stocks. Illegal fishing is also a problem on the Baltic Sea (Eesti kalanduse strateegia 2014–2020, 2013).

Aquaculture

The production and sales volumes of Estonian aquaculture products have significantly reduced regardless of major investments made during the last decade. In 2011 and 2012, the aquaculture products` sales volume was lower than 400 tons. Export of Estonian aquaculture products has been relatively modest. The main article has been the eel that is sold to a Holland processing undertaking. Sturgeons and crayfish have also been exported in small amounts. The main opportunity to increase export is to farm species that suit to Estonian farming conditions and have a high demand abroad, such as the eel, the crayfish, the sturgeon, the whitefish and perspective new species, and development work to support this activity. Export is the only target for most of these species, because Estonian market will remain too small to allow effective production (Eesti vesiviljeluse arengustrateegia 2014–2020). Fish and crayfish are farmed in Estonian inland waterbodies based on recirculation. Pound-based farming has not been practiced in Estonia.

In Estonia, offshore aquaculture practice includes some individual cases. In the opinion of experts, no appropriate competence in this field exists in Estonia. Although there are suitable sites in the sea, they are few. Farming in pounds makes this type of aquaculture more competitive, because of lower energy consumption and smaller capital costs. The common opinion of the representatives of this sector is that pound farming in the sea is an option that must be studied and tested in Estonian conditions (Eesti vesiviljeluse arengustrateegia 2014–2020). Currently, there are some seawater-based fish farms. The above is the reason why aquaculture cannot be considered as linked to the sea and a field that provides economic income from sea (TÜ Eesti Mereinstituut, 2012). However, there is a potential to develop aquaculture-related business in the same areas as offshore windfarms (Jaanuska, 2015).

To develop offshore aquaculture, the objective is set to map the regions that are suitable for offshore aquaculture (Figure 2.21), test them and, if suitable, make investments into production.

Offshore aquaculture requires taking into consideration currents, depth, ice cover, channels, nature protection areas, dumping, military objects, fishing, spawning, breeding and nesting grounds. When the production targets export markets, it is important to find niche products that have no strong competitors on the market, but there is a target group to whom to offer the products. The niche products that have a high demand abroad should suit the farming conditions in Estonia.

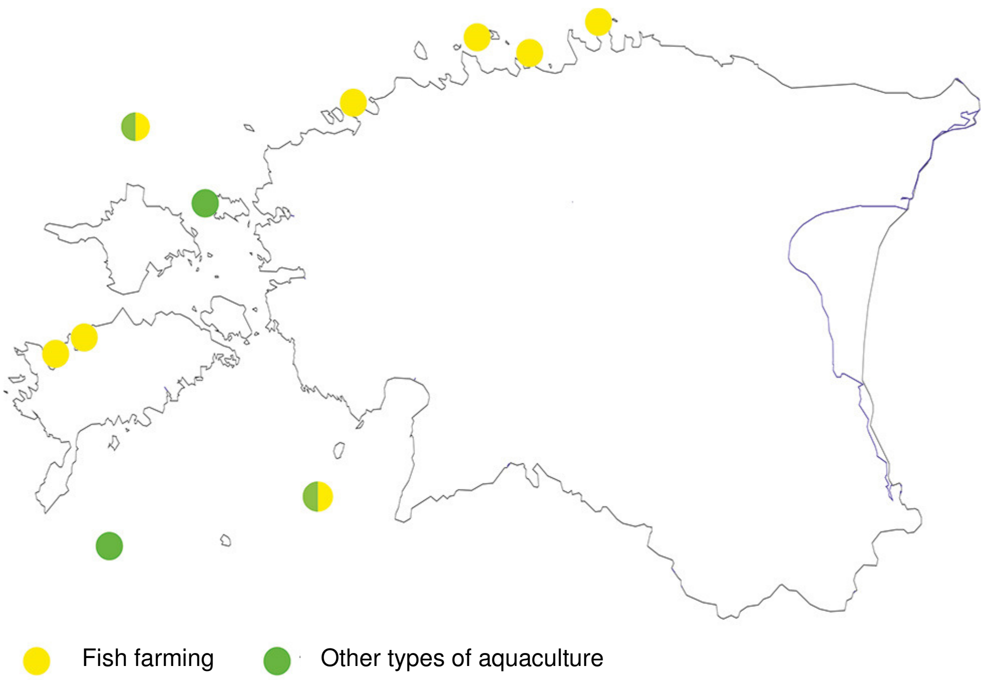

Figure 2.21. Marine areas suitable for the development of aquaculture (Source: Jaanuska, 2015).

It is possible to farm the steelhead trout, the whitefish, and macroalgae in the marine area. The Baltic Sea is a more complex environment for growing bivalve molluscs due to too low seawater salinity (Jaanuska, 2015). However, aquaculture of bivalve molluscs and algae is a business worth studying. Bivalve molluscs' colonies are able to clean large amounts of water from organic matter, improving so water quality and reducing eutrophication of the marine environment. Combined aquaculture is also possible, which means that fish and algae or bivalve molluscs are farmed in the same region to balance the movement of nutrients in the marine environment. As fish farming is presumed to increase nutrient content in water, then combined with algae or bivalve molluscs farming a large portion of nutrients added to the water column by fish farming is used up by algae or bivalve molluscs, ensuring that water quality does not change much (OÜ Alkranel *et al*., 2015).

As there exist regions that are potentially suitable for offshore aquaculture, offshore aquaculture in Estonian conditions should be studied and tested. To develop offshore aquaculture, the following is necessary (Jaanuska, 2015):

- ✓ **The nutrients loop principle must be introduced into the Environmental Code. If feed is made from fish caught from the Baltic Sea, a permit for special use of water is awarded under a simplified procedure for the farming of fish of same amount containing the same amount of phosphorous that is bound in the feed.**
- ✓ **Obtaining of vaccination equipment that is necessary to continue farming salmonids in the sea.**

- ✓ **The problem of building rights has to be resolved, because it makes the process of starting using seawater areas very long.**

2.3.3 Marine transport and ports (including maritime rescue)

Because of its geographic location, Estonia lays along an important international east-west trading route. According to HELCOM (2014), the main traffic happens in norther part of the Baltic Sea in the Gulf of Finland (Figure 2.22). Most of the traffic is caused by cargo vessels and tankers. The main Baltic Sea area routes are presented on Figure 2.23.

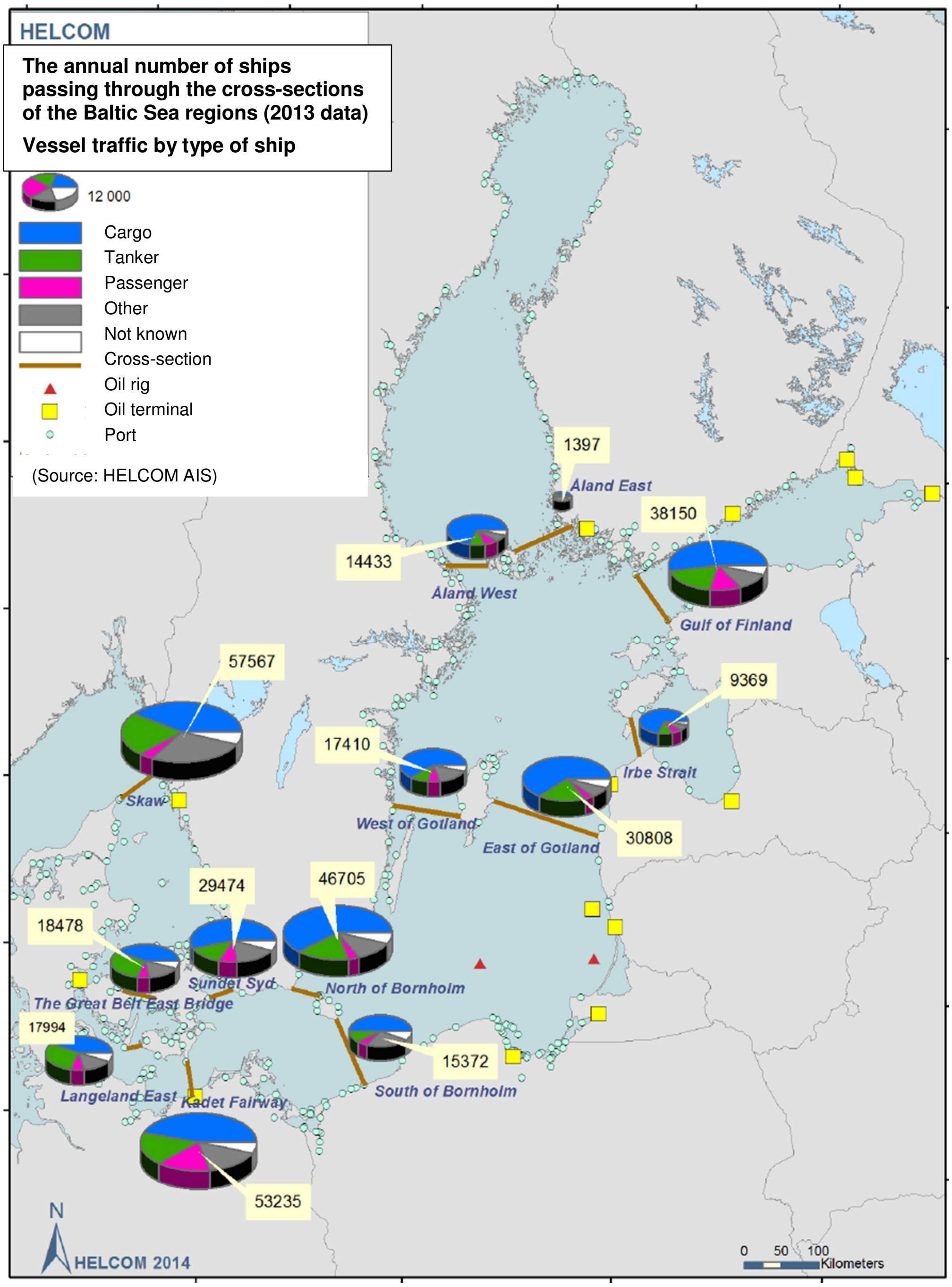

Figure 2.22. Number of ships that pass through intersections of the Baltic Sea areas annually (2013). Source: HELCOM, 2014.

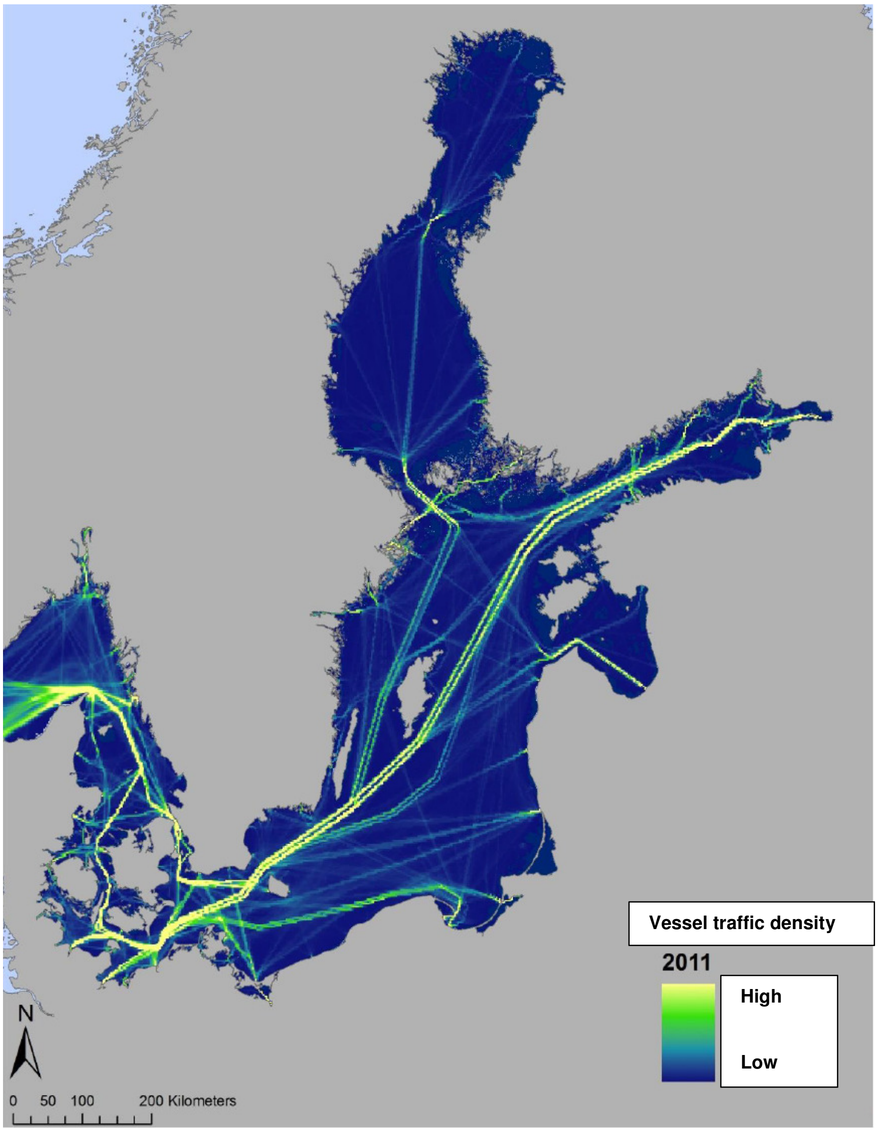

Figure 2.23. Location of main waterways, areas of more intensive traffic are marked in yellow (Vessel traffic data of 2011). Source: HELCOM, 2014.

The total length of waterways in Estonian marine areas is 1,700 km, whereas the routes of international importance (HELCOM routes) account for a half of it (950 km). The length of inland waterways is 350 km (Eesti Merenduspoliitika 2012–2020, 2011). According to the National Spatial Planning *Estonia 2030+* (2012), Estonian marine transport has three levels:

1. international traffic;
2. local traffic (e.g. ferry traffic);
3. recreational craft traffic (smaller fishing ships, yachts, fishing boats), also seasonal marine tourism and water sports (kayaks, surfing etc.).

Ports service international and internal carriage of passengers and goods. Almost whole transit of goods goes through ports (Transpordi arengukava 2014–2020, 2013). The most important ports are Muuga Port and Paldiski Southern Port that belong to AS Tallinna Sadam and Sillamäe Port, Kunda Port, Pärnu Port and Paldiski North Port that belong to private owners.

The good features of Estonian ports are their geographic location as well as good natural conditions of the largest Estonian cargo ports: due to relatively good ice conditions, they are better navigable than many other Gulf of Finland ports. The depth of ports is sufficient for even receiving larger (100,000 – 125,000 dwt) ships. Muuga Port is able to service even larger ships that can pass the Danish straits. Besides, the larger ports have all necessary infrastructure and connections with railway and road networks. The latter is especially important in the functioning of an integral transport chain.

However, the market share of Estonian ports has dropped on the eastern coast of the Baltic Sea (including Poland and Russia) in 10 years from 18% to 10% (AS PwC, 2014). The reasons for these changes are different, starting with relations with Russia (including slow Estonian-Russian border, Russia`s preference for own ports) to the competition with other Baltic countries` ports and problems between ports and local authorities but also insufficient marketing of Estonian transport corridor at the international level. Major progress has been made in the latter during recent years, e.g. launch of Estonian Shortsea Shipping Centre (SPC Estonia) in 2012 or the activity of the logistics cluster on target markets.

Estonian ports have a strong leading position in terms of passenger carriage in the Baltics (AS PwC, 2014). The main passenger carriage route is between Tallinn-Helsinki. For example, the number of international passengers grew in 2013 year-on-year by approximately 400,000 people or 4.5% to the record high 9.2 million passengers. The drivers of this growth were the increased number of shipping line travellers on the largest Tallinn-Helsinki route as well as record high number of cruise ship passengers that reached approximately 530,000 passengers (Majandus- ja Kommunikatsiooniministeerium, 2014).

Besides large ports, small and fishing harbours play an important role not only on the local level but also internationally. The development of sailing and recreational tourism depends primarily on the establishment of a network of small harbours and financing their investments and development of diverse coastal tourism products in their neighbourhood. A plan for establishing a network of small harbours for 2014–2020 was prepared in 2014 by the Ministry of Economic Affairs and Communications (approved in April 2014). The plan focuses on the efficient implementation of Estonian recreational craft tourism and it establishes a network of harbours which distance from each other is up to 30 nautical miles and which development the state supports. According to the concept, the network of Estonian small harbours contains 63 larger harbours that have development potential (Majandus- ja Kommunikatsiooniministeerium, 2014).

The Estonian Baltic Sea trawlers discharged fish to 17 landing points in Estonia in 2012. The largest amounts of fish were discharged in Dirhami, Veere, Miiduranna, Westmeri, Virtsu, Meeruse, Lehtma and Mõntu harbours. Most of the problems that most of the fishing harbours servicing trawlers have are poor condition of roads that lead to the quay and harbour and water supply and utility systems in the harbours. At the same time, washing equipment and ice machines, with which not all trawler harbours are equipped, are important. Fish from coastal fishing activities was discharged in 477 landing points close to the coast and inland water bodies in 2012. The harbours and landing points are generally in poor technical order and do not meet the requirements of the *Ports Act* and marine safety conditions. The quays and technical equipment used for landing and initial processing of fish are obsolete. The buildings where to store fish or keep fishing gear are dilapidated or there are not such buildings at all. There are many harbours with no electricity and water supply systems. With the aid of the European Fisheries Fund, it was started to renovate fishing harbours in 2010. By the end of 2015 it is planned to renovate 60 fishing ports and landing points (Eesti kalanduse strateegia 2014–2020, 2013).

The navigable inland water bodies in Estonia are usually shallow and consequently are suitable primarily for recreational craft. The number of moorings in harbours is usually small, the way in and basins narrow and shallow. The public sector has very little interest in the development of inland waterbodies, because there is no clear vision about their potential. This has resulted in a weak cooperation between public, private and third sector. The most burning strategic issue regarding the development of inland waterbodies is how to open them up to the Gulf of Finland. Narva falls and the facilities of the hydropower plant that are in Narva city do not allow traffic from the Gulf of Finland to Lake Peipsi by any waterborne vessel. Connection with the Gulf of Finland would significantly increase the number of tourists on inland water bodies and accelerate thereby local economy (Eesti Merenduspoliitika 2012–2020, 2011).

Search and rescue operations of people in distress at sea under Estonia`s responsibility and on Lake Peipsi, Lake Lämmi and Lake Pihkva are carried out by the Police and Border Guard Board. Maritime rescue is ensured with the readiness of small units at coastal border points. Voluntary marine rescue is well-developed through organisations that form MTÜ Eesti Vabatahtlike Mere- ja Järvepääste. For improved organisation of maritime rescue operations, the *Riigikogu* adopted in 2012 amendments to the legislation that regulate the general principles, competence, organisation of work, training, approving, benefits and securities, requirements and releasing from the voluntary marine rescuer status of the voluntary marine rescuers. The Police and Border Guard Board launched a base course of maritime rescue in 2012 (Majandus- ja Kommunikatsiooniministeerium, 2013). In 2013, a contract was made for the establishment of a new ultrashort wave maritime communication network. The range of the new network compared to the old one is much better, because of two additional support stations in Suuremõisa in Hiiumaa and in Pärnu. In addition to the marine area A1, which is also the area of responsibility of Estonian maritime rescue, the navigable inland water bodies, such as Narva reservoir and Narva River and Lake Peipsi and Lake Lämmijärv, were covered by the end of 2014 (Majandus- ja Kommunikatsiooniministeerium, 2014).

As the Baltic Sea is an ecologically easily threatened marine area and a pollution-sensitive ecosystem and also a region with intensive traffic, efforts must be continued to improve navigational safety and security in the region. It is also important to continue improving maritime rescue capacity (including, for example, updating of the relevant equipment). From the socio-economic point of view, it is important to address the issue of harbours (including small and fishing harbours) and development of their infrastructure.

2.3.3 Natural resources (mineral resources, wind) and using thereof

The mineral resources in the Estonian marine areas are sand and sea mud, wind and wave energy potential and algae in the marine area could be considered natural resources.

The largest deposits of **mineral resources** in the marine area that have been registered are located west and northwest of Hiiumaa where are Hiiumadal and Kõpu sand deposits. Furthermore, an 34 million m^3 of building sand resources have been estimated to lie north of Kõpu peninsula. The largest amounts in recent years were excavated in Naissaare deposit where about 1.8 million m^3 sand was extracted in 2008–2010. Ihasalu and Kuradimuna sand deposits are close to Tallinn. Letipea deposit lies north of Kunda which is estimated too hold 2 million m³. Perspective building and filling sand areas are located east of Letipea, in the area of Uhtju and Barabanovi banks (http://geoportaal.maaamet.ee/, Maavarude koondbilansid, 31.08.2015). In Estonia, sea mud is also extracted (Käina, Haapsalu), but the amounts are small (compared to resources). In 2001–2010, altogether 7,800 tons of sea mud was extracted in Estonia (http://www.stat.ee, 31.08.2015).

Mineral resources (sand, fill, mud) are excavated from the sea bottom for construction purpose to fill up port areas, restore coast or some other construction purpose. Earth matter is extracted from the sea bottom and the material is dumped to the sea bottom in another location when port basins and waterways are dredged.

Kassari Bay is a habitat for a **red algae species** *Furcellaria lumbricalis,* from which furcellaran is produced that can be used as a stabilising, thickening and gelatinizing substance in food, agriculture, cosmetics and pharmacy industries. In Kassari Bay, red algae is gathered by trawling, but it is also harvested in the coastal areas. So far, this algae species has been gathered only on the coast of Saaremaa (74,873…208,056 kg dry algae was harvested in 2010–2012).

Estonia`s western coastal sea is primarily suitable for the establishment of **offshore windfarms** (National Spatial Planning "*Estonia 2030+*"; Figure 2.24). Estonia`s northern coastal sea, Lake Peipsi and Lake Võrtsjärv are not suitable for the establishment of windfarms due to natural conditions and national defence purposes.

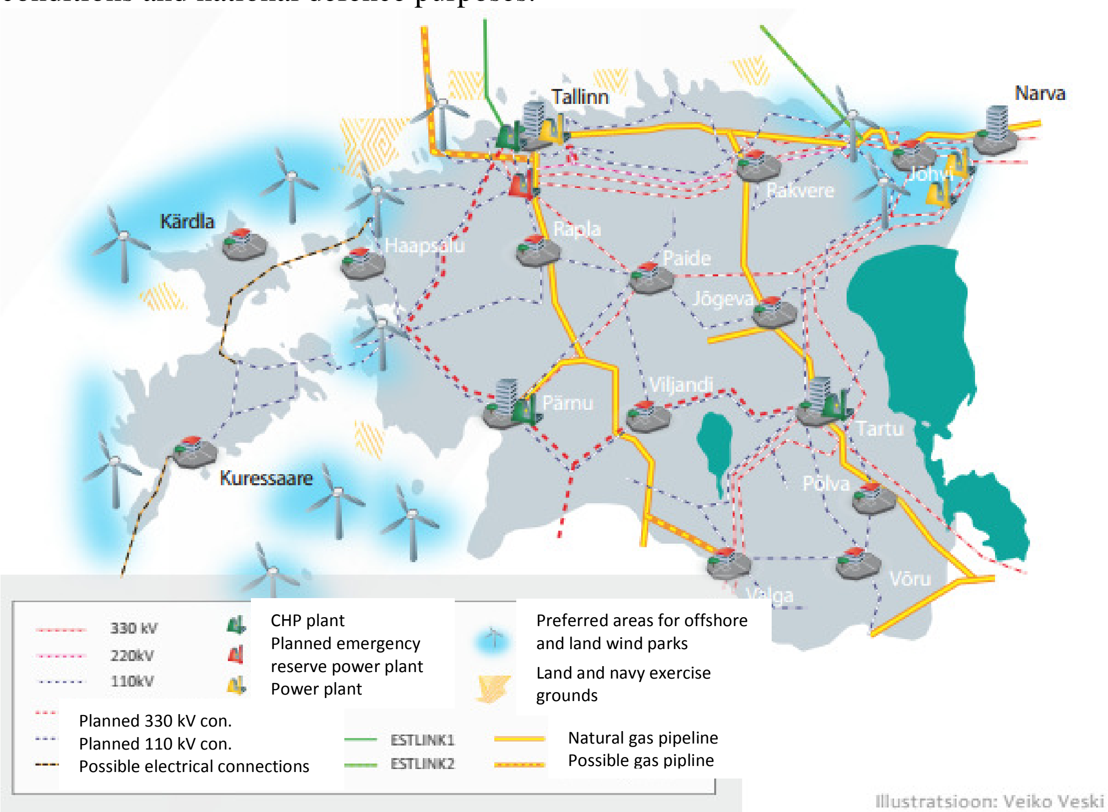

Figure 2.24. An extract from the National Spatial Plan "Estonia 2030+" with preferred areas for offshore windfarms.

According to Estonian Wind Power Association (Eesti Tuuleenergeetika Assotsiatsioon), as of the end of 2013, there were 130 land-based operative wind generators with the total power of 279,90 MW in Estonia. Most of these wind generators are located in Saaremaa, western Estonia and Viru County coastal areas, the windiest locations in Estonia (Hiiu maakonnaga piirneva mereala maakonnaplaneering, 2014). Currently, there are no wind generators and windfarms in the marine areas.

Although no marine areas are planned to be used for wind energy development in the *Wind energy thematic plan of Lääne County plan* (2013) and the *Wind energy thematic plan of Saare County plan* (2013), the principle locations of transmission lines (Figure 2.25) are marked and an option to join the Latvian power grid is included as a potential transmission line in the *"Wind energy thematic plan of Pärnu County plan"* (2013).

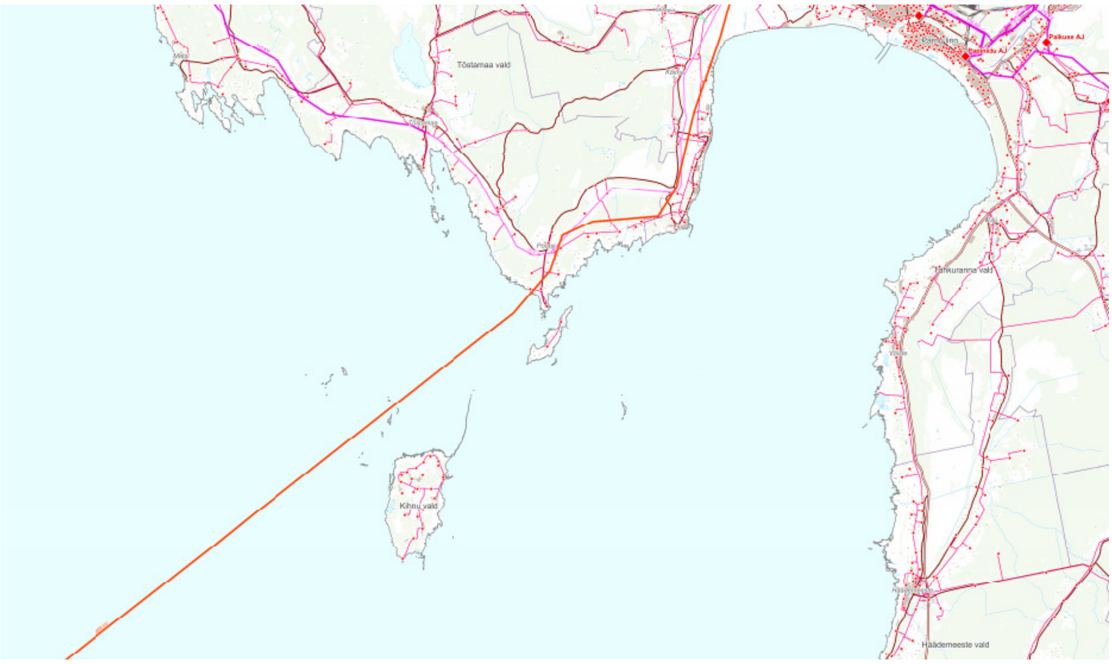

Figure 2.25. An extract of the "Wind energy thematic plan of Pärnu County plan" (2013) where the orange line shows the potential location of a transmission line across the marine area.

Potential areas (Figure 2.26) for the construction of windfarms that are at least 12 km from the coast are shown in the *County plan of the marine area bordering Hiiu County* (not adopted). There is a plan to establish a connection between Hiiumaa and dry land over the Vormsi Island, which would improve supply certainty, because this way a circular supply system is created. It is also possible to connect larger new consumers in Hiiumaa or improve the connecting options for the existing consumers.

Potential areas (Figure 2.27) for the construction of windfarms that are at least 10 km from the coast are shown in the *County plan of the marine area bordering Pärnu County* (not adopted).

According to the *Estonian Energy Management Development Plan up to 2018*, the production volume of offshore windfarms is planned to be 200 MW in 2016–2017 and 500 MW in 2018–2025. However, for 2030, Estonia`s offshore wind energy resource potential was estimated at 1550 MW (the relevant yearly production 5,839 GWh) for the erection of offshore windfarms (Eesti Arengufond, 2013). The *Estonian Renewable Energy Action plan up to 2020* specifies as an action supporting offshore windfarm establishment with investment aid upon finding tariff free financing sources.

Collusions of ships with wind generators damage generators as well as ships and may cause environmental pollution. Although the probability of ship collusions is estimated to be low on the basis of the web site (www.offshorewindenergy.org) that gathers offshore windfarm related information such measures must be taken that will reduce even more the probability of accidents and collusion risks and damage and potential environmental impact when wind generators are built in the area.

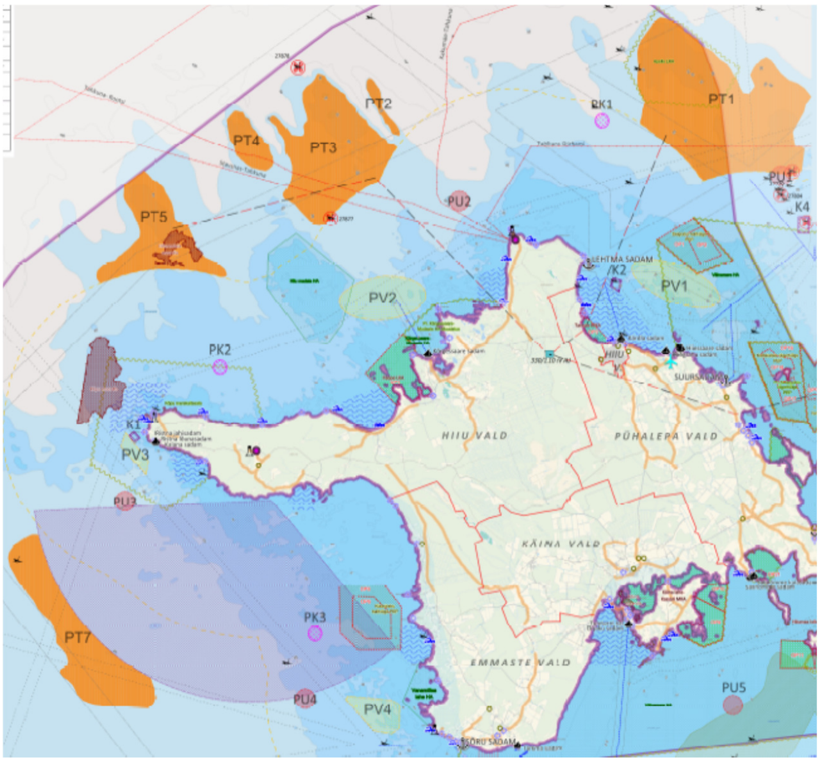

Figure 2.26. An extract from the *County plan of the marine area bordering Hiiu County* (not adopted as of October 2015). Orange areas mark the potential areas for building offshore wind parks.

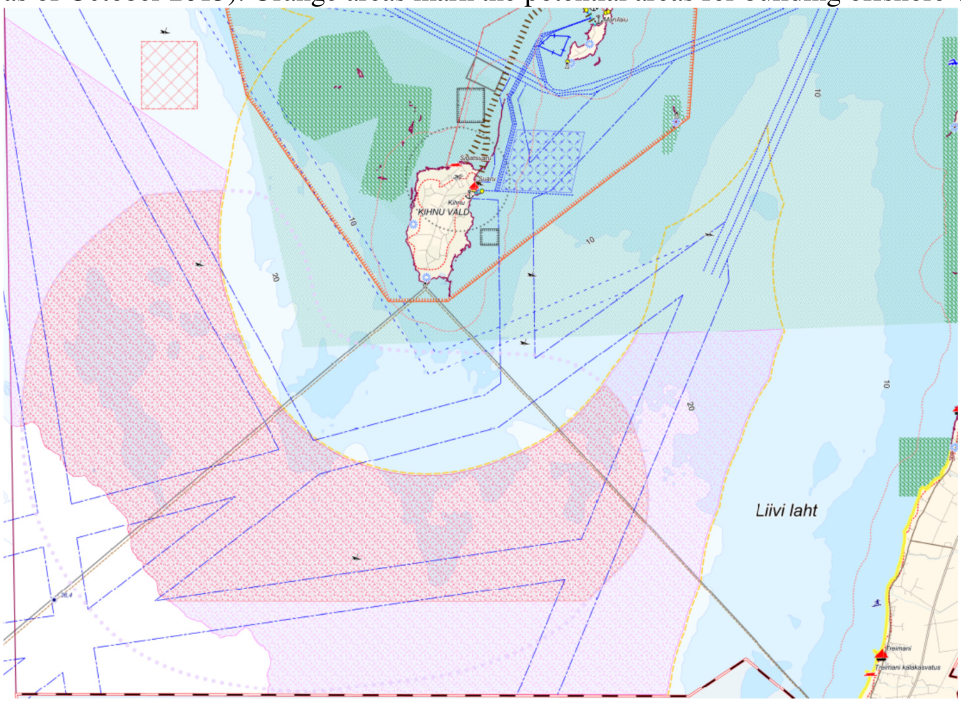

Figure 2.27. An extract from the *County plan of the marine area bordering Pärnu County* (not adopted as of October 2015). Lilac areas mark the potential areas for building offshore wind parks.

The potential of wave energy in Estonian coastal waters has been studied in a Masters thesis of Tallinn University of Technology (Tallinnna Tehnikaülikool) (Eelsalu, 2013). The thesis shows that wave energy potential exists in the entire Baltic Sea. The result of the work is that the theoretical wave energy total capacity in Estonia`s open sea par of the Baltic Sea is 700 MW. A central problem for using wave energy is seasonal ice cover of the Baltic Sea. There are several ongoing projects that study the possibility to produce electricity for local use from wave energy in the icing sea (for example, Interreg IVA programme project WESA; www.wesa.ax). Nevertheless, it can be said that this energy producing method will be used in future, if only in a limited way.

There are several sea-based natural resources that are used or can be potentially used. It is important to find a balance between using natural resources and related potential environmental impacts.

2.3.4 Marine cultural heritage and traditional coastal lifestyle

Estonia has a rich sea-related cultural heritage be it cultural objects in the sea or the traditional coastal lifestyle.

There are numerous wrecks that have been designated as heritage protection objects in the Estonian waters. However, there are a lot of such wrecks in the sea that have not been entered into the list of cultural objects because the processing of wrecks is in progress or it has not been possible to conduct studies to classify the wrecks as cultural objects. A positive aspect is that a separate wreck register has been established by the national register of cultural monuments.

In addition to wrecks, cultural objects are also sea related buildings and facilities on the coast, such as lighthouses. Nowadays, the importance of lighthouses as a navigational aid is gradually diminishing, but they have an important historic value and tourist attraction potential. This rises the problem how to conserve historically valuable lighthouses and other navigational equipment for future generations, because the authorities that are responsible for ensuring safe navigation cannot be given the task to conserve historic property. Former coastal military buildings characteristic to certain historical periods (Soviet times as well as earlier periods) in Estonia can be considered cultural property (e.g. Käsmu Maritime museum is in a border point building that originates from the time of Czar rule (Lahemaa rahvuspargi kaitsekorralduskava 2016–2025 tööversioon, May 2015).

Estonia has a long coastline with varied coastal landscape and many accesses to the sea. Beautiful nature, traditional coastal villages with interesting history and cultural heritage (including harbour sites, boat landings, boat sheds etc.) and experienced fishermen that carry the tradition of coastal fishing are characteristic of the coastal living environment. Different cultures and communities (the Old Believers, the Seto, the Russians, the Estonians) make different coastal areas unique (Eesti Merenduspoliitika 2012–2020, 2011). However, the coastal villages have low population density, decreasing and ageing population, few jobs and insufficient infrastructure. During the past century, the coastal lifestyle has suffered drastic changes for historic reasons. The coastal fishing tradition is fading away, the work traditions and handicraft skills related to coastal life are fading away, and coastal landscapes have grown over with shrubs or are under strong construction pressure. Along with the fading traditional coastal lifestyle, also memories about the former life on the coast are forgotten. However, there are still people around that remember the life in the coastal areas in the 20th century, but their memories need to be studied and preserved.

In coastal villages, there is unused potential for developing tourism services and other small businesses and creating a high-quality living environment (Eesti kalanduse strateegia 2014–2020, 2013). With the finances of the European Fisheries Fund, renovation of small harbours and landing points, processing of fish products and agar-agar and direct marketing, development of fishing related tourism and enlivening of coastal villages, diversification of fishermen activities in other times than during fishing season and training has been supported in recent years.

Maritime and coastal lifestyle heritage should be kept alive and made visible to people and accessible to all interested. Although these activities are mainly focused on the coastal areas, it must be also taken into account that maritime image has to be improved among inland habitants by promoting the opportunities about sea access and coastal tourism possibilities.

2.3.5 Maritime education and research and development activity

Maritime education

As maritime subject is an interdisciplinary field, maritime education is provided by various educational institutions. Maritime education is mostly offered at Estonian Maritime Academy of Tallinn University of Technology (TTÜ Eesti Mereakadeemia) that provides professional higher education and Master`s level studies. The institution also offers continual vocational training for maritime specialists. Vocational education is given at Estonian Maritime School (Eesti Merekool). Education is provided in Tallinn (vocational training and professional higher education and continual vocational training), in Pärnu (continual vocational training) and in Tartu (inland navigation vocational training). In cooperation with Orissaare Gümnaasium (upper secondary school) and Kuressaare Täiskasvanute Gümnaasium (upper secondary school for adult) vocational training is offered to the students of these schools in Saaremaa. In cooperation with Kuressaare College of Tallinn University of Technology (Tallinna Tehnikaülikooli Kuressaare Kolledž) recreational craft builders are taught in Saaremaa. Certain maritime fields are taught at Tallinn University of Technology, Tallinn University of Applied Sciences, Tallinn University and Estonian University of Life Sciences. Vocational training related to maritime affairs is also offered at Kuressaare Vocational School (recreational craft building), Hiiumaa Vocational School (small harbour specialist) and Tallinn Transport School (logistic) (Eesti merenduspoliitika 2012–2020, 2011).

In Estonia, maritime science and education development concept must be created that would integrate the existing maritime science and education potential and would efficiently allocate the existing resources. By strengthening existing competence centres and developing field-related modules, a structured curriculum system should be created to ensure an opportunity to get education at every level from vocational education to research-based Doctoral studies. Among other things, the problem that only 30% of the places allocated to the Maritime Academy and Maritime School can be provided vocational education (Eesti merenduspoliitika 2012–2020, 2011).

The educational institutions must organise, coordinate and support learning abroad in such maritime educational fields and levels which education in Estonia is not feasible to develop due to small demand but there is a certain need on the Estonian labour market for such specialists. The increase of maritime competence of authorities should be supported also (Eesti merenduspoliitika 2012–2020, 2011).

Currently, there is a serious deficiency of ship`s officers in the EU and rating of EU citizens. On the one hand, the reason is increased in international carriage of goods; on the other hand, decreased interest towards the profession of seaman in the EU Member States. In Estonia, there is excess of seamen with good qualification, but the national shipping industry has been decreased from the beginning of the 1990s. This has created a situation where we export our labour force to other EU Member States (Eesti merenduspoliitika 2012–2020, 2011).

Marine monitoring and development activity

Within the Estonian national environmental monitoring programme, marine monitoring is conducted that includes monitoring and distant monitoring of the coastal sea, high seas and sea coasts. The general objective of monitoring is to detect the impact made by human activity on the Baltic Sea and determine its scope in the context of natural changes, including giving assessment of efficiency of quantitative and qualitative measures taken and gathering background data necessary for adjusting and amending protection measures. The monitored parameters are content of nutrients in seawater, phytoplankton and marine plankton spatial and temporal distribution, changes in benthic species, content of hazardous substances in marine organisms etc. (seire.keskkonnainfo.ee). In addition to sea monitoring within the framework of the national environmental monitoring programme also marine biota (e.g. fish fauna, seals, sea islands breeding birds etc.) is monitored within the nature diversity and landscape monitoring sub-programme.

Sea is also studied with one-time specific projects. BONUS EEIG (*BONUS for the Baltic Sea science – network of funding agencies*) has been established for the organisation of scientific research of the Baltic Sea in cooperation with the EU and the countries surrounding the Baltic Sea which main objective is to coordinate and support sea research activities in the Baltic Sea region (Eesti merenduspoliitika 2012–2020, 2011).

The European Union has supported the decision to take measures for the establishment of a monitoring system with a better resolution to connect the existing monitoring and observation systems that are used for ensuring safe navigation and security, monitoring of the marine biota and quality of water, determining the status of marine environment, assessing the efficiency of measures implemented for the protection of the marine environment, detecting and eliminating marine pollution, fishing control, protecting external borders and other law enforcement activities (Eesti merenduspoliitika 2012–2020, 2011).

Marine monitoring requires common coordinated activity because currently the tasks are divided between five different ministries. The Police and Border Guard Board under the Ministry of Interior is responsible for protecting the sea border and ensuring general protection of public order in the Estonian marine areas, but also searching and rescuing people in distress in the Estonia`s area of responsibility and detecting, localizing and liquidating marine pollution. The Estonian Maritime Administration is responsible for safe and secure traffic in Estonian marine areas. Estonian Navy performs national defence tasks in the Estonian marine areas that affect navigation safety (including mine clearance, shooting exercises etc.). The task of the Environmental Inspectorate is to control the marine environment protection and fishing rules in the Estonian marine areas. The National Heritage Board (Muinsuskaitseamet) under the

Ministry of Culture organises protection and supervision over underwater monuments. The Ministry of the Environment organises national monitoring of the environment. Currently, the entire marine monitoring system does not give the entire picture for the users of different authorities because there is not a uniform information exchange system between the authorities (Eesti merenduspoliitika 2012–2020, 2011).

Because the marine environment and maritime industry are important, it is necessary to continue providing quality marine education and facilitate scientific research and continue with marine monitoring.

2.3.6 Air quality, including traffic noise in the air environment

Air quality

Exhausts from marine transport deteriorate air quality and bring into the environment undesirable nutrients (Kalli *et al.*, 2013). It has been found that CO_2, NO_X, SO_2 and $PM_{2.5}$ emissions originating from the traffic on European waters accounts for 10–20% of the marine transport emissions of the entire world. CO_2-emissions from both local and international ships that visit European (EU-27) ports account for up to 30% (EEA, 2013). In 2009, in the European SECA (see explanation below) the main marine transport generated emissions were caused by container and RoPax ships that emitted, for example, 43% of SO_x emissions caused by the vessel traffic in the region. The other sources of emissions are general cargo vessels, chemicals tankers and ro-ro ships (Kalli *et al.*, 2013).

Research conducted in the North Sea has shown that *ca* 89% marine transport related emissions occur up to 50 nautical miles from the coast and *ca* 97% up to 100 nautical miles from the coast. Globally, the relevant indicators are *ca* 70% of emissions up to 400 km from the coast (EEA, 2013). It has been found that in the neighbourhood of the European SECA larger ports (including Tallinn) are high $PM_{2,5}$ concentrations (per square kilometre) that exceed even the relevant concentrations in the most intensive traffic regions (Johansson *et al.*, 2013). However, recent air quality studies conducted in the neighbourhood of Tallinn, Helsinki and Turu ports within the framework of the SNOOP project (Kousa *et al.*, 2013) show that air pollution indicators of Tallinn were lower compared to Helsinki and Turu cities. This is due also to the better location of the port in Tallinn. The same study (Kousa *et al.*, 2013) has come to the conclusion that although air pollution generated by vessel traffic and related activities in the ports has an impact on human health, it is much smaller compared to air pollution generated by city traffic. The main problem pollutant is superfine solid particles $PM_{2.5}$ (Kalli *et al.*, 2013).

The main air quality problems of other Estonian ports are related to Muuga Port and Sillamäe Port (Eesti Keskkonnauuringute Keskus, 2012). The air quality problem in these areas is not related to traffic, but the goods handled at these ports (primarily smell problems). Both ports are located near densely populated areas and in a region where air quality is influenced significantly also by industrial companies.

Pollution from marine transport is regulated by the International Marine Organisation (IMO) convention (Regulations for the Prevention of Air Pollution from Ships) MARPOL 73/78 Annex VI. Until 2008, the convention allowed to use ship fuels with sulphur content 4.5% in all marine regions, except for established *sulphur emission control areas* or SECAs, where the maximum sulphur content was not allowed to exceed 1.5%. As emissions from ships have significantly increased the acidification problem that haunts the Northern Europe, IMO has designated the Baltic Sea, the North Sea and La Manche as SECAs in the EU (Euroopa Komisjon, 2011).

As a result of international call to implement additional measures in order to reduce the emissions caused by marine transport, the parties to the IMO convention reviewed MARPOL Annex VI at the end of 2008. As a result of the review, the content of sulphur in fuels used on all seas shall be gradually reduced to 0.5% from 2020 and in SECAs to 0.1% from January 2015. Provisions which purpose is to ensure compliance with the requirements are technologically neutral and the requirements may be fulfilled by reduction of emissions with alternative methods, such as exhaust gas cleaning systems, or using alternative clean fuels, such as liquefied gas (LNG) (Euroopa Komisjon, 2011).

According to Johansson *et al*. (2013), the restriction on sulphur content during 2009–2011 significantly reduced marine transport generated SO_x-and $PM_{2,5}$-emissions. SO_x-emissions have reduced ca 33% and $PM_{2,5}$-emissions ca 20%. Because of the requirement to reduce the sulphur content of ship fuel, SO_x-emissions and $PM_{2,5}$-emissions will continue to reduce. However, the requirements regarding marine traffic generated nitrogen oxides (NO_x) apply only on taking into exploitation of new ships. Consequently, NOx caused air pollution emitted by marine transport is reduced at the same pace as fleets are renewed (Kalli *et al*., 2013). As regards CO_2-emissions, Kalli and others came to a conclusion in their study (2013) that if the European Commission will not implement new measures it is not realistic to achieve a reduction of CO_2-emissions to 40% of the 2005 level. One potential measure is to use cleaner fuels, e.g. liquefied natural gas (LNG).

Exhaust gas emissions generated by marine transport are significant because they deteriorate air quality and bring undesirable nutrients to the environment. Of the exhaust gases that are released into air, SO_2 causes acidification and NO_x eutrophication. Therefore, it is important to deal with reduction of air pollution.

Vessel traffic noise in the air environment

Because ships that sail along waterways that are far away, the level of noise caused by ships may be considered insignificant compared to the noise that reaches the water environment and affects the water biota (see section 2.2.2). Noise caused by ships that transfers via air will be important primarily in the region of ports for the people that live in the region.

Larger and historical ports are usually located in cities or in densely populated areas or close-by. Even if a port was initially planned outside the city centre, the pressure to develop areas along the coast as residential and recreational areas, which happens also in areas close to ports. Usually noise caused by activities in ports can be considered local, which scope of influence is some hundred metres from the port area (Mustonen, 2013). However, in cases where ports are located in a city, port generated noise will become important, and this especially in co-influence with other noise sources in the city (street traffic, industrial buildings, etc.).

There are several sources of noise in a port and their existence and location depends on the specific port. Usually, noise generated in a cargo port is considered stronger compared to noise caused in a passenger port. However, passenger ports are usually located in the city centre, which is why they have to deal with the residents that are not satisfied with the port-generated noise. Noise may be caused in ports by vehicles operating in the port, vehicles that enter or exit the territory of the port, railway, ships that moor in the port etc. (Mustonen, 2013).

It is hard to control noise generated in ports because of many factors, for example, extensive port areas in the open air, acoustic reflective surfaces (including closeness to water), noise sources with different noise emissions (including tone, impulses) that are located at different heights etc. (Mustonen, 2013). Regardless, there are certain measures that can be taken to alleviate noise. For example, in case of large ports, it is possible to plan noisy activities as far as possible outside of urban environment, impose speed limits on vehicles that drive on the port`s territory, use less noisy machines, ensure electricity supply connections from shore to ships, construction of noise barriers etc. The need to use the mentioned measures depends on the particular port and the specific noise situation. When improving noise situation, measures that help avoid causing of noise are preferred, followed by noise alleviating measures (e.g. control of speed).

In Estonia, according to the Health Board (Annex 1 – an opinion issued for the SEA programme) there have been complaints of residents about noise from the port territory in addition to Tallinn port also in Muuga, Miiduranna and Pärnu port areas. In order to assess and improve noise situation, relevant measurements and modelling of the level of noise are conducted based on which noise alleviating measures are developed. In Estonia, noise studies are conducted when new ports are built, when the existing ports are expanded or when the current situation is mapped.

Noise generated by ship traffic that travels through air is important in terms of human wellbeing and health primarily for the people that live in port regions. Consequently, it is especially important to pay attention to the noise topic when ports are developed.

3. OBJECTIVE, METHOD AND SCOPE OF STRATEGIC ENVIRONMENTAL ASSESSMENT

According to the Environmental Impact Assessment and Environmental Management System Act § 2 (2), the purpose of strategic environmental assessment is to: 1) contribute to the integration of environmental considerations into the preparation and adoption of strategic planning documents; 2) provide for a high level of protection of the environment; 3) promote sustainable development.

Assessment of impacts on implementing the strategic choices that are the basis of the strategic environmental assessment give relevant information to the authority that has to adopt the strategic development document prior to making a decision what will happen after the decision has been made. The purpose of impact assessment is to give the author of the strategic development document information about the environmental impact that will occur when the measures are implemented.

A strategic environmental assessment is conducted in compliance with the Environmental Impact Assessment and Environmental Management System Act (under the version that was in effect until 30 June 2015) and current relevant guidance materials. SEA is based on the principle that significant impacts, both negative and positive, that are likely to occur with the implementation of the strategic development document are assessed. An environmental impact is materially negative if it may presumably exceed the environmental capacity of the place of business, cause irreversible changes in the environment or risk human health and wellbeing, cultural heritage or property. An environmental impact is materially positive if it will decrease the presumed significant load on the environment (e.g. reduces environmental pollution or exploitation of resources) or measures are ensured that help maintain or improve the status of natural areas, improve human health and wellbeing and maintain cultural heritage or property.

Two main methods are used when preparing the SEA: compliance analysis and external impacts analysis.

Compliance analysis is an assessment of the measures of the programme of measures to determine whether they are in agreement with other strategic documents that have relevant objectives (compliance of the measures of programme of measures with the objectives set in an European Union policy as well as correspondence of the programme of measures with other relevant national strategic documents in Estonia).

External impacts analysis is an approach during which the planned activities are compared against a set of external impacts. During the external effects analysis, it is analysed which nature, economic and social fields and to what extent are influenced by the measures of the programme of measures and if necessary suggestions are made for improving the measures of the programme of measures in terms of environmental aspects. Also, if necessary, alternative options will be suggested or additional measures to mitigate negative impacts and proposals to amplify positive impacts are made. The assessments given during the SEA process are generally short-term and long-term.

During the external impacts analysis, the impacts are primarily assessed qualitatively (descriptively) in various nature and socio-economic environments. Based on the SEA programme (Annex 1), the presumed impacts associated with the implementation of the programme of measures will be assessed in the following sections:

1. On the natural environment (including water environment, atmosphere, seafloor and coasts):
    - Impact on marine biota and habitats (including impact on the protected nature objects and protection objectives of Natura 2000 areas and the integrity of the areas);
    - Impact on the quality of seawater and physical indicators of marine environment (including underwater noise);
    - Impact on the quality of air and climate changes;
    - Impact on the sustainable use of natural resources and resources.

2. On the socio-economic environment:
    - Impact on human wellbeing and health (including outdoor noise);
    - Impact on marine business environment (including fishing, aquaculture, tourism etc.);
    - Impact on marine transport and ports (including navigation safety and security);
    - Impact on marine cultural heritage.

As SEA is based on the principle of the strategic development document level of precision, also impacts will be assessed on a more general level than in case of a detailed plan or activity permit; however, no additional studies will be conducted during the SEA process. When giving assessments, the existing monitoring, statistics and research data are used.

The scope of the impacted area addressed during the SEA process is different by the respective fields. Generally, the area of impact stretches from the coast to the border of Estonia`s economic zone, except for cross-border impact.

4. COMPLIANCE ANALYSIS OR RELATIONS OF THE MEASURES OF THE PROGRAMME OF MEASURES WITH OTHER STRATEGIC DOCUMENTS

In this section, the most important documents related to the programme of measures have been described and a compliance analysis has been conducted to determine whether the measures of the programme of measures correspond with the objectives set in these documents. As the *National programme for 2004–2014 for the reduction of phenol emissions input to water* has expired by now, this document has not been discussed in this section (it was mentioned in the SEA programme).

4.1 Regional and European Union documents

HELCOM Baltic Sea Action Plan to 2021

The Baltic Sea Action Plan to 2021 was approved on the meeting of HELCOM ministers on 15 November 2007. The vision of HELCOM is to ensure a healthy Baltic Sea environment, with diverse biological components functioning in balance, resulting in good environmental/ecological status and supporting a wide range of sustainable human economic and social activities. The Action Plan includes six goals (Table 4.1). In order to implement the Baltic Sea Action Plan, an implementation plan for 2012–2015 has been prepared in Estonia.

Table 4.1. Interlinkage of the measures of the programme of measures with the goals of HELCOM Baltic Sea Action Plan

Goals	Interlinkages with the new measures of the Programme of Measures
1. Baltic Sea unaffected by eutrophication	• Promotion of use of liquefied natural gas (LNG) as ship fuel. • Reduction of disposal of untreated wastewater into the sea, including ensuring reception of wastewater from cruise ships in ports. • Additional nutrient, hazardous substance and litter inflow reductions from stormwater directly to the sea – the construction of stormwater sewerage and treatment systems.
2. Baltic Sea undisturbed by hazardous substances	• Promotion of use of liquefied natural gas (LNG) as ship fuel. • Reduction of disposal of untreated wastewater into the sea, including ensuring reception of wastewater from cruise ships in ports. • Additional nutrient, hazardous substance and litter inflow reductions from stormwater directly to the sea – the construction of stormwater sewerage and treatment systems. • Improving the efficiency of marine pollution prevention capacity to respond to environmental emergencies at sea.

	• Control of environmental risks that accompany bunkering operations at sea. • Prevention of the marine littering problem and organisation of awareness building environmental educational and clean-up events. • Reducing the use of plastic bags, supporting relevant publicity and educational activities. • Preparing and implementing action plans of local authorities in coastal regions and implementing them for the purpose of reducing and preventing marine litter. • Organisation in ports a common marine litter reception system.
3. Favourable status of Baltic Sea biodiversity	• Establishing of marine protection areas network in Estonia`s economic zone. • Adoption and implementation of the ringed seal protection plan. • Development of regional aquaculture plans to control possible environmental pressure. • Awareness building about non-indigenous species to control their invasion. • Ratification of the international Ballast Water Management Convention (BWMC), facilitation of implementation by participation in the regional information system and its implementation. • Developing regional fishing restrictions and updating limit sizes of commercial fish. • Adjusting catching capacity to meet the conditions of good environmental status.
4. Environmentally friendly maritime activities on Baltic Sea	• Development of regional aquaculture plans to control possible environmental pressure. • Awareness building about non-indigenous species to control their invasion. • Ratification of international Ballast Water Management Convention (BWMC), facilitation of implementation by participation in the regional information system and its implementation. • Developing regional fishing restrictions and updating limit sizes of commercial fish. • Promotion of realisation of low-value fish. • Adjusting catching capacity to meet the conditions of good environmental status. • Promotion of use of liquefied natural gas (LNG) as ship fuel. • Reduction of disposal of untreated wastewater into the sea, including ensuring reception of wastewater from cruise ships in ports.

	• Additional nutrient, hazardous substance and litter inflow reductions from stormwater directly to the sea – the construction of stormwater sewerage and treatment systems. • Adoption of restrictions on vessel traffic in case of wave exposure impact. • Improving the efficiency of marine pollution prevention capacity to respond to environmental emergencies at sea. • Control of environmental risks that accompany bunkering operations at sea. • Improving the marking system of fishing gear for better control and prevention of abandoning fishing gear. • Preparing an action plan to improve control over fishing gear and clean the sea of abandoned fishing gear. • Prevention of the marine littering problem and organisation of awareness building environmental educational events and cleaning sprees. • Reducing the use of plastic bags, supporting relevant publicity and educational activities. • Preparing and implementing action plans of local authorities in coastal regions to prevent and reduce marine litter. • Organisation in ports a common marine litter reception system.
5. Development of assessment tools and methods	The measures of the programme of measures have no direct link to the goal of HELCOM Baltic Sea Action Plan, but indirectly supports the development of the SEA assessment tools and methods.
6. Awareness raising and capacity building	• Awareness building about non-indigenous species to control their invasion. • Control of environmental risks that accompany bunkering operations at sea. • Improving the efficiency of marine pollution prevention capacity to respond to environmental emergencies at sea. • Improving the marking system of fishing gear for better control and prevention of abandoning fishing gear. • Preparing an action plan to improve control over fishing gear and clean the sea of abandoned fishing gear. • Prevention of the marine littering problem and organisation of awareness building environmental educational events and cleaning sprees.

	• Reducing the use of plastic bags, supporting relevant publicity and educational activities. • Preparing and implementing action plans of local authorities in coastal regions to prevent and reduce marine litter. • Organisation in ports a common marine litter reception system. • Establishing an impulsive sound register.

Baltic Sea Regional Action Plan for Marine Litter

Baltic Sea Regional Action Plan for Marine Litter was adopted in Helsinki on the 36th annual meeting of HELCOM on 4 March 2015. The following planned measures in the Baltic Sea Regional Action plan for Marine Litter (Table 4.2) are related to the measures of the programme of measures.

Table 4.2. Interlinkage of the measures of the programme of measures with the Baltic Sea Regional Action Plan for Marine Litter

Marine litter plan measure	Interlinkage with the new measures of the programme of measures
Through multinational projects, such as the MARELITT Baltic project, together with the fishing industry and other stakeholders, develop and promote best practice in relation to ALDFG and derelict fishing gear and their removal.	• Improving the marking system of fishing gear for better control and prevention of abandoning fishing gear.
Mapping of snagging sites or historic dumping grounds and a risk assessment for identifying where accumulation of ghost nets pose a threat to the environment and should be removed	• Preparing an action plan to improve the control over fishing gear and clean the sea of abandoned fishing gear.
To prepare information sheets to assist Contracting parties in developing material for education programs, especially for professional seafarers, including fishermen, highlighting the marine litter problem and including codes of practice in cooperation with relevant organisations.	• Prevention of the marine littering problem and organisation of awareness building environmental educational and clean-up events.
Define and implement appropriate instruments and incentives to reduce the use of plastic bags, including the illustration of the associated	• Reducing the use of plastic bags, supporting relevant publicity and educational activities.

costs and environmental impacts (e.g. establishment of levies, deposit fees, taxes or bans on plastic bags). Support regional coordination in the Baltic Sea of the implementation of the Directive 94/62/EC on packaging and packaging waste to reduce the consumption of lightweight plastic carrier bags, for HELCOM Contracting Parties being EU members.	
Prepare and agree on HELCOM guidelines on marine litter references to be included in national and local waste prevention and waste management plans, i.a. an element highlighting the impacts of marine litter.	• Preparing and implementing action plans of local authorities in coastal regions to prevent and reduce marine litter.
Implementation of the ISO standard (ISO 201070:2013) in relation to port reception facilities. Differentiate ports according to their size. Promote the development of regional statistics on waste collected in ports based on existing information as far as possible. Facilitate and disseminate best practices in relation to all relevant waste handling aspects in the fishing sector (including waste management on-board and in ports, processing loss).	• Organisation in ports a common marine litter reception system.

European Union Biological Diversity Strategy to 2020

The strategy is aimed at reversing biodiversity loss and damaging of ecosystems in the European Union (EU) by 2020 by defining six priority objectives (Table 4.3). This strategy helps to fulfil the two main obligations taken by the EU leaders in March 2010 – restrict loss of biological diversity in the EU by 2020 and protect and value biodiversity and the ecosystem services it provides in the EU and restore them by 2050.

Table 4.3. Interlinkage of the measures of the programme of measures with the targets of the EU Biodiversity Strategy to 2020

Targets	Interlinkage with the new measures of the programme of measures
1. Fully implement the birds and habitats directives	• Establishing a marine protection areas network in Estonia`s economic zone. • Adoption and implementation of the ringed seal protection plan.
2. Maintain and restore ecosystems and their services	All new measures included in the programme of measures support the objective of the EU Biodiversity Strategy.
3. Increase the contribution of agriculture and forestry to maintaining and enhancing biodiversity	The new measures of the Programme of Measures have no direct link to the objective of the European Union Biodiversity Strategy. The links are through the water management plans as a measure to fight diffused pollution.
4. Ensure the sustainable use of fisheries resources	• Developing regional fishing restrictions and updating limit sizes of commercial fish. • Promotion of realisation of low-value fish. • Adjusting catching capacity to meet the conditions of good environmental status.
5. Combat invasive alien species	• Awareness building about non-indigenous species to control their invasion. • Ratification of the international Ballast Water Management Convention (BWMC), facilitation of implementation by participation in the regional information system and its implementation.
6. Help avert global biodiversity loss	All new measures included in the programme of measures support the objective of the EU Biodiversity Strategy.

The European Union Strategy for the Baltic Sea Region

The Baltic Sea Region Strategy is a European Union initiative that aims at finding solutions to main bottlenecks that hinder development of the region by dealing with the region specifically. The Strategy aims at reinforcing cooperation within the region in order to better target and focus on the most important. The initiative has four strategic targets – environment, prosperity, accessibility and safety and security. Depending on the targets, four main tasks that require quick attention have been determined (Table 4.4).

Table 4.4. Interlinkage of the measures of the programme of measures with the objectives of the EU Strategy for the Baltic Sea Region

Objectives	Interlinkage with the new measures of the programme of measures
1. Ensure sustainable environment	All new measures of the programme of measures support more or less fulfilment of this objective.
2. Promote development of the region	• Developing regional aquaculture plans to control a possible environmental pressure. • Developing regional fishing restrictions and updating limit sizes of commercial fish. • Promotion of realisation of low-value fish. • Promotion of use of liquefied natural gas (LNG) as ship fuel.

Objectives	Interlinkage with the new measures of the programme of measures
	• Reduction of disposal of untreated wastewater into the sea, including ensuring reception of wastewater from cruise ships in ports. • Additional nutrient, hazardous substance and litter inflow reductions from stormwater directly to the sea – the construction of stormwater sewerage and treatment systems. • Improving the efficiency of marine pollution prevention capacity to respond to environmental emergencies at sea. • Improving the marking system of fishing gear for better control and prevention of abandoning fishing gear. • Preparing and implementing action plans of local authorities in coastal regions to prevent and reduce marine litter. • Organisation in ports a common marine litter reception system.
3. Increase accessibility and attractiveness of the region	The measures of the programme of measures have no direct link to the objective of the EU Strategy for the Baltic Sea Region.
4. Ensure safety and security of the region	• Adopting restrictions on ship traffic in case of wave exposure impact. • Improving the efficiency of marine pollution prevention capacity to respond to environmental emergencies at sea. • Control of environmental risks that accompany bunkering operations at sea.

The new measures specified in the programme of measures are not in conflict with the objectives set down in regional and European Union documents.

4.2 National documents of Estonia

National Spatial Plan Estonia 2030+

The National Spatial Plan Estonia 2030+ is a strategic document aiming at achieving the expedient utilisation of space on the scale of Estonia as a whole. The National Spatial Plan is being prepared for the entire territory of the nation. The plan specifies as the main development objective ensuring that any settled location in Estonia is habitable. This requires a high-quality living environment, good, convenient mobility facilities and the supply of essential networks. The plan was adopted on 30 August 2012.

The plan sets as objectives for 2030:

- Estonia is a nation with a cohesive spatial structure, a diverse living environment and has good links to the external world.

- Compact, high-quality centres (cities and towns) with urban space provide the residents in their daily activity space with services at good levels, job creating high added value and competitive education.
- Rural areas provide people with privacy of residence, the ability to cope regardless of external circumstances and a natural living environment.
- Low-density space functions when good mobility facilities are provided.
- Estonia`s good links, in all directions, with the external world by air, across water and overland improve the position of Estonia`s cities and towns in the international division of labour.
- A sustainable regional public transport system employing flexible and smart solutions for sparsely populated areas, providing a smooth flow of life in the areas of its impact and enables people to commute easily and conveniently between their places of residence and work and service and educational institutions.
- The availability of high-quality energy at acceptable prices ensures the development of entrepreneurship and facilities for living everywhere in Estonia.
- Estonia is open to the sea.

The measures included in the programme of measures help improve the state of the marine environment that encourages sea-related activities (tourism, fishing etc.) and consequently supports the goal of the National Spatial Plan – Estonia is open to the sea.

Estonian Environmental Strategy to 2030

The Estonian Environmental Strategy to 2030 is a strategy for developing the sphere of the environment which builds upon the principles of the National Strategy on Sustainable Development "Sustainable Estonia 21" and serves as the basis for the preparation and revision of all sector-specific development plans within the sphere of the environment. The strategy was approved by the *Riigikogu* with its decision of 14 February 2007.

The Environmental Strategy sets the following objectives (Table 4.5):

1. Sustainable use of natural resources and reduction of waste generation:
    - Waste – By 2030, waste disposed to landfills will have decreased 30% and the harmfulness of waste generated will have been reduced significantly.
    - Water – To achieve good condition of surface water (including coastal water) and groundwater, and to maintain the bodies of water whose conditions is good or very good.
    - Mineral resources – Environmentally sustainable extraction of mineral resources which is sustainable in terms of water, landscapes and air, and efficient exploitation of mineral resources with minimum losses and waste.
    - Forest – Balanced satisfaction of ecological, social, cultural and economic needs in the course of utilisation of forests in a very long perspective.
    - Fish – To ensure good condition of fish populations, diversity of fish species and avoid the indirect negative impact of fishing on the ecosystem.
    - Game – To ensure the diversity of the species of game and other game and the violability of populations.
    - Soil and use of land – 1. Environmentally sustainable utilisation of soil; 2. Functionality and sustainable utilisation of natural and cultivated landscapes.

2. Preservation of the diversity of landscapes and biodiversity:
- Landscapes – Preservation of multifunctional and coherent landscapes.
- Biodiversity – To ensure the existence of habitats and biotic communities necessary for the preservation of viable populations of species.

3. Climate change mitigation and quality of ambient air:
- Energy – To produce energy in an amount that meets the consumption needs in Estonia and to develop diverse and sustainable production technologies based on different sources of energy, which do not impose a significant burden on the environment and which enable electricity to be produced for export.
- Energy consumption – To slow down and stabilise the consumption of energy, while ensuring that the needs of people are met, i.e. to ensure the preservation of the volume of primary energy while consumption grows.
- Protection of the ozone layer – Phase-out of artificial substances used in industry and households, which deplete the ozone layer.
- Transport – To develop an efficient, environmentally sustainable and comfortable public transport system, ensure safe soft traffic (render alternatives of using motor vehicles more comfortable) and develop a settlement and production structure that reduces inevitable commuting traffic and road transport (i.e. to reduce the need for transportation).

4. The environment, health and quality of life:
- Outdoor environment – Outdoor environment that spares and supports health.
- Interior space – Safe interior space that advances the preservation of health.
- Food – The content of pollutants in the food chain which originate from the environment does not harm human health.
- Drinking and bathing water – Drinking and bathing water does not harm human health.
- Disused hazardous sites – All currently known disused hazardous sites will be eliminated by 2030.
- Safety and protection of the population – Ensure the safety and protection of people against risks jeopardising their security.

Table 4.5. Interlinkage of the measures of the programme of measures with the objectives of the Estonian Environment Strategy to 2030

Objectives	**Interlinkage with the new measures of the programme of measures**
1. Sustainable use of natural resources and reduction of waste generation	• Developing regional fishing restrictions and updating limit sizes of commercial fish • Promotion of realisation of low-value fish. • Adjusting catching capacity to meet the conditions of good environmental status. • Promotion of use of liquefied natural gas (LNG) as ship fuel. • Reduction of disposal of untreated wastewater into the sea, including ensuring reception of wastewater from cruise ships in ports. • Additional nutrient, hazardous substance and litter inflow reductions from stormwater directly to the

Objectives	Interlinkage with the new measures of the programme of measures
	sea – the construction of stormwater sewerage and treatment systems. • Improving the efficiency of marine pollution prevention capacity to respond to environmental emergencies at sea. • Control of environmental risks that accompany bunkering operations at sea. • Improving the marking system of fishing gear for better control and prevention of abandoning fishing gear. • Preparing an action plan to improve control over fishing gear and clean the sea of abandoned fishing gear. • Prevention of the marine littering problem and organisation of awareness building environmental educational events and cleaning sprees. • Reducing the use of plastic bags, supporting relevant publicity and educational activities. • Preparing and implementing action plans of local authorities in coastal regions to prevent and reduce marine litter. • Organisation in ports a common marine litter reception system.
2. Preservation of the diversity of landscapes and biodiversity	• Establishing a marine protection areas network in Estonia`s economic zone. • Adoption and implementation of the ringed seal protection plan. • Developing regional aquaculture plans to control a possible environmental pressure. • Awareness building about non-indigenous species to control their invasion. • Ratification of the international Ballast Water Management Convention (BWMC), facilitation of implementation by participation in the regional information system and its implementation. • Developing regional fishing restrictions and updating limit sizes of commercial fish. • Adjusting catching capacity to meet the conditions of good environmental status.
3. Climate change mitigation and quality of ambient air	• Promotion of use of liquefied natural gas (LNG) as ship fuel.
4. The environment, health and quality of life	• Promotion of use of liquefied natural gas (LNG) as ship fuel. • Reduction of disposal of untreated wastewater into the sea, including ensuring reception of wastewater from cruise ships in ports. • Additional nutrient, hazardous substance and litter inflow reductions from stormwater directly to the

Objectives	Interlinkage with the new measures of the programme of measures
	sea – the construction of stormwater sewerage and treatment systems. • Improving the efficiency of marine pollution prevention capacity to respond to environmental emergencies at sea. • Control of environmental risks that accompany bunkering operations at sea. • Preparing an action plan to improve control over fishing gear and clean the sea of abandoned fishing gear. • Reducing the use of plastic bags, supporting relevant publicity and educational activities. • Preparing and implementing action plans of local authorities in coastal regions to prevent and reduce marine litter. • Organisation in ports a common marine litter reception system. • Establishing an impulsive sound register.

National Sustainable Development Strategy to 2030 "Sustainable Estonia 21"

The National Strategy "Sustainable Estonia 21" sets out the principles of Estonian sustainable development and defines the strategy of the state and society of Estonia to 2030. The strategy was approved by the *Riigikogu* on 14 September 2005. The strategy includes four development goals (Table 4.6):

- Viability of the Estonian cultural space;
- Growth of welfare;
- Coherent society;
- Ecological balance that has three main components:
  - Use of natural resources in ways and quantities that ensure ecological balance;
  - Reduction of pollution;
  - Preservation of biodiversity and natural areas.

Table 4.6. Interlinkage of the measures of the programme of measures with the objectives of Sustainable Estonia 21

Goals	Interlinkage with the new measures of the programme of measures
Viability of the Estonian cultural space	The measures of the programme of measures do not have a direct link to the goal of Sustainable Estonia 21.
Growth of welfare	• Developing regional aquaculture plans to control a possible environmental pressure. • Promotion of realisation of low-value fish.
Coherent society	• Prevention of the marine littering problem and organisation of awareness building environmental educational events and cleaning sprees. • Reducing the use of plastic bags, supporting relevant publicity and educational activities.

	• Preparing and implementing action plans of local authorities in coastal regions to prevent and reduce marine litter.
Ecological balance	All measures of the Programme of Measures support the goal of the "Sustainable Estonia 21".

Nature Conservation Development Plan until 2020

The Nature Conservation Development Plan is a strategic base document for the development of sectors related to the conservation and use of nature until 2020. The development plan has been approved by the Government of the Republic order No. 332 of 26 July 2012.

The strategic objectives of the development plan (Table 4.7):

1. People are familiar with, appreciate and conserve nature and know how to use their knowledge in their everyday life:
- Measure 1.1. Promoting nature education at all levels of education.
- Measure 1.2. Effective dissemination of nature information.
- Measure 1.3. Promoting and applying conservation science to achieve the objectives of practical conservation management.
- Measure 1.4. Management of sustainable nature tourism.

2. Conservation management to ensure the favourable conservation status of species and habitats and the diversity of landscapes so that habitats function as a coherent ecological network:
- Measure 2.1. Ensuring the favourable conservation status of species.
- Measure 2.2. Ensuring the favourable conservation status of habitats.
- Measure 2.3. Ensuring landscape diversity.
- Measure 2.4. Conservation management of natural objects.
- Measure 2.5. Ensuring the availability of nature data and storing scientific collections.
- Measure 2.6. International cooperation to conserve biodiversity.
- Measure 2.7. Compensating for nature conservation restrictions and providing financial support to conservation activities.

3. Long-term sustainability of natural resources, and the preconditions for this, are ensured and the principles of ecosystem approach are followed in the use of natural resources:
- Measure 3.1. Taking account of the value of ecosystem services in the use of the environment.
- Measure 3.2. Analysing the impacts of earth resources extraction causing the loss of biodiversity; developing and implementing mitigation measures.
- Measure 3.3. Analysing the impacts of renewable natural resources management causing the loss of biodiversity; developing and applying mitigation measures.
- Measure 3.4. Analysing and mitigating the negative impacts of transport.
- Measure 3.5. Mitigating the negative impacts of climate change on biological diversity.
- Measure 3.6. Ensuring biological safety.
- Measure 3.7. Analysing the negative impacts of the use of renewable energy on biodiversity; developing and applying mitigation measures.

Table 4.7. Interlinkage of the measures of the programme of measures with the goals of the Nature Conservation Development Plan until 2020

Goals	Interlinkage with the new measures of the Programme of Measures
1. People are familiar with, appreciate and conserve nature and know how to use their knowledge in their daily lives	• Awareness building about non-indigenous species to control their invasion. • Prevention of the marine littering problem and organisation of awareness building environmental educational events and cleaning sprees. • Reducing the use of plastic bags, supporting relevant publicity and educational activities. • Preparing and implementing action plans of local authorities in coastal regions to prevent and reduce marine litter.
2. The favourable conservation status of species and habitats and diversity of landscapes in ensured and habitats are functioning as a coherent ecological network	All measures included in the programme of measures support the goal of the Nature Conservation Development Plan.
3. Long-term sustainability of natural resources is ensured and the principles of the ecosystem approach are followed in the use of natural resources	• All measures included in the programme of measures support the goal of the Nature Conservation Development Plan.

Estonian Fisheries Strategy 2014–2020

Estonian Fisheries Strategy for 2014–2020 includes Estonia`s state of fish stock, coastal fishing, trawling, recreational fishing, distant water fishing, processing, marketing, as well as research and development activities. The main objective of the strategy is the sustainable development of Estonian fisheries industry as a branch of economy and increasing the competitiveness of the fish production in the domestic and foreign markets (Table 4.8). The strategy was approved on 2 April 2013.

Table 4.8. Interlinkage of the measures of the programme of measures with the objectives of the Estonian Fisheries Strategy 2014–2020

Objective	Interlinkage with the new measures of the programme of measures
1. Turn Estonia into an important logistics centre of Baltic herring and sprat that are intended for human consumption.	The new measures of the programme of measures have no direct link to the objective of the Estonian Fisheries Strategy.
2. Popularise, develop and diversify recreational fishing and fishing tourism and branches of economy that offer services to it.	• Improving the marking system of fishing gear for better control and prevention of abandoning fishing gear. • Preparing an action plan to improve control over fishing gear and clean the sea of abandoned fishing gear.
3. Improve economic sustainability of coastal and inland waters fisheries.	• Developing regional fishing restrictions and updating limit sizes of commercial fish. • Promotion of realisation of low-value fish.

Objective	Interlinkage with the new measures of the programme of measures
	• Adjusting catching capacity to meet the conditions of good environmental status. • Improving the marking system of fishing gear for better control and prevention of abandoning fishing gear. • Preparing an action plan to improve control over fishing gear and clean the sea of abandoned fishing gear.
4. Ensuring opportunities to fish for Estonian companies and maintaining balance between catching capacity and catching possibilities.	• Developing regional fishing restrictions and updating limit sizes of commercial fish. • Adjusting catching capacity to meet the conditions of good environmental status.
5. Development of a favourable functional environment for fish processing, such as education, product development, utilisation of new environmentally sustainable technologies, innovation and marketing. Also increasing availability of fish and its consumption.	• Promotion of realisation of low-value fish.
6. Development of a favourable, sustainable and profitable operational environment for aquaculture.	• Developing regional aquaculture plans to control a possible environmental pressure.
7. Achieving a balance between commercial and recreational fishing and optimal use of resourced in the fisheries sector, improve efficiency of supervision and build the fishing culture that adheres to requirements.	• Developing regional fishing restrictions and updating limit sizes of commercial fish. • Promotion of realisation of low-value fish. • Adjusting catching capacity to meet the conditions of good environmental status. • Improving the marking system of fishing gear for better control and prevention of abandoning fishing gear. • Preparing an action plan to improve control over fishing gear and clean the sea of abandoned fishing gear.
8. Development of cooperation between research, development and educational institutions and the sector that is measured by the monetary volume of development projects to the fisheries GDP.	The new measures of the programme of measures has no direct link to the objective of the Estonian Fisheries Strategy.

National Waste Management Plan for 2014–2020

The National Waste Management Plan for 2014–2020 is a development document that includes the whole waste management sector and that describes the most important principles and measures of waste management development together with planned activities for the next seven years. The objective of the Waste Management Plan is to put in order and organise waste management systemically at all levels of the sector. The Waste Management Plan was approved on 13 June 2014.

The plan has set strategic objectives (Table 4.9), in which an activity that is necessary for achieving every strategic goal has three measures. The waste management plan is implemented based on an operational plan.

1. Prevent and reduce waste generation, including decreasing hazardousness of waste:
    - Measure 1 – Promotion of prevention of waste generation and reduction of hazardousness of waste.
2. Recycling of waste or recover them for some other way at the maximum level
    - Measure 2 – Promotion of waste collection and recovery and efficiency of waste reporting.
3. Reduction of waste originating environmental risk, by way of improving monitoring and supervision, among other efforts
    - Measure 3 – Reduction of environmental risk originating from waste and improving efficiency of monitoring and supervision.

Table 4.9. Interlinkage of the measures of the programme of measures with the objectives of the National Waste Management Plan for 2014–2020

Objective	Interlinkage with the new measures of the Programme of Measures
1. Prevent and reduce waste generation, including decreasing hazardousness of waste	• Additional nutrient, hazardous substance and litter inflow reductions from stormwater directly to the sea – the construction of stormwater sewerage and treatment systems. • Improving the marking system of fishing gear for better control and prevention of abandoning fishing gear. • Prevention of the marine littering problem and organisation of awareness building environmental educational events and cleaning sprees. • Reducing the use of plastic bags, supporting relevant publicity and educational activities. • Preparing and implementing action plans of local authorities in coastal regions to prevent and reduce marine litter. • Organisation in ports a common marine litter reception system.
2. Recycling of waste or recover them for some other way at the maximum level	• The new measures of the programme of measures have no direct link to the objectives of the Waste Management Plan.
3. Reduction of waste originating environmental risk, by way of improving monitoring and supervision, among other efforts	• Improving the marking system of fishing gear for better control and prevention of abandoning fishing gear. • Preparing an action plan to improve control over fishing gear and clean the sea of abandoned fishing gear. • Prevention of the marine littering problem and organisation of awareness building environmental educational events and cleaning sprees.

Objective	Interlinkage with the new measures of the Programme of Measures
	• Reducing the use of plastic bags, supporting relevant publicity and educational activities. • Preparing and implementing action plans of local authorities in coastal regions to prevent and reduce marine litter. • Organisation in ports a common marine litter reception system.

National Tourism Development Plan for 2014–2020

National Tourism Development Plan for 2014–2020 is a document that focuses on the efficient implementation of Estonia`s tourism sector development potential, building on the prior achievements, taking into account the current situation and global trends. The main objective of the Development Plan is to ensure Estonia`s competitiveness and international attractiveness as a tourism destination. The Development Plan includes three sub-objectives.

1. Estonia is known as a travel destination, is well accessible and Estonia`s tourism products and services are competitive internationally

- Measure 1.1. Increasing awareness about Estonia as a travel destination, including promotion of internal tourism
- Measure 1.2. Management of tourism information
- Measure 1.3. Management of tourism products development
- Measure 1.4. Monitoring of tourism development possibilities and development of business environment

2. Estonia`s tourism attractions and events organised in Estonia are internationally interest evoking and create travel motivation

- Measure 2.1. Development of tourism attractions that are interesting in the international arena
- Measure 2.2. supporting of international events and participation in organisation of events

3. Estonia`s tourism destinations and their integral tourism products are competitive internationally

- Measure 3.1. Development of regional tourism products

The new measures included in the programme of measures help improve the state of marine environment that has an indirect positive impact on tourism because of cleaner seawater and beaches.

Estonian Rural Development Plan for 2014–2020

The implementation mechanism for the rural development policy for 2014–2020 sets down improving of strategic approach through the common rural development policy priorities at the European Union level. There are altogether six of these applicable priorities for the entire community and they are the basis for the programming of rural resources.

Priority 1: Improving knowledge transfer and innovation in the agricultural and forestry sector and rural areas

- Objective 1: Functioning cooperation, timely research and development, and knowledge transfer between the manufacturer, the processor, the adviser and the researcher.

Priority 2: Improving the viability of agricultural holdings and the competitiveness of all agricultural forms in all areas and promoting innovative agricultural technologies and sustainable forest management

- Objective 2: Viable and sustainable food production-oriented agricultural sector is competitive, resource-efficient, and with sustainable age structure.

Priority 3: Promoting the organisation of food chain in agriculture, including the processing and marketing of agricultural products, animal welfare, and risk management

- Objective 3: Holdings engaged in the production and processing of agricultural products have market power and they cooperate in producing, processing, and marketing agricultural products.

Priority 4: Restoring, preserving and improving agricultural and forestry ecosystems

- Objective 4: Agricultural land use is environmentally friendly and takes into account regional specifics; the preservation of agriculture and forestry with biodiversity, traditional landscapes and high nature value are ensured.

Priority 5: Promoting resource efficiency and supporting the transition to low-CO2 emission and climate resilient economy in agriculture and food and forestry sectors

Objective 5: Agriculture and the food industry has made energy saving and energy efficiency investments, greenhouse gas and ammonia emissions are reduced and the conservation and capture of CO2 has been promoted in agriculture and forestry.

Priority 6: Promoting social inclusion, poverty reduction and the rural economic development

- Objective 6: Rural economy and living environment in rural areas are diverse, provide alternative employment opportunities for labour force released from agriculture and are based on local resources and potential-based solutions.

The new measures of the programme of measures has a link to the objectives of the Estonian Rural Development Plan through the new measures that address aquaculture and fisheries that support the objectives 1, 2 and 4 of the Estonian Rural Development Plan.

National Development Plan "Estonian Marine Policy for 2012–2020"

The National Development Plan "Estonian Marine Policy 2012–2020" is a cross-sector development plan approved by the Government of the Republic, which summarises the strategic objectives and necessary activities for achieving them to improve the development of the marine sector. The development plan has set priorities and objectives for the development of the marine sector, which are following (Table 4.10):

Priority 1 – The marine business environment is business friendly and internationally competitive:

- Objective 1 – Estonian shipping is internationally competitive.
- Objective 2 – Increased trade flows through Estonian ports.
- Objective 3 – Increased number of passengers on international shipping lines.
- Objective 4 – Estonian shipbuilding and repair operations are internationally competitive.

Priority 2 – Marine sector is secure, safe and the state of the marine environment has improved:

- Objective 5 – The safety and security in vessel traffic and in ports has improved.
- Objective 6 – The state of the marine environment has improved.

Priority 3 – The actions of the public sector support marine development:

- Objective 7 – The marine sector management and marine regulations are more effective.

Priority 4 – Estonian marine education and research and development are up to date:

- Objective 8 – Estonian education system provides modern training in balanced volume of specialists necessary for all fields of the marine sector.
- Objective 9 – The quantity and quality of Estonian marine research have increased.

Priority 5 – The coastal living and visit environment are attractive, favouring marine tourism and local business development, the marine cultural heritage is carried forward:

- Objective 10 – Marine tourism and marine and coastal business activities are developed.
- Objective 11 – The preservation of marine cultural heritage and traditions is secured.

Table 4.10. Interlinkage of the measures of the programme of measures with the objectives of the National Development Plan "Estonian Marine Policy 2012–2020"

Objectives	**Interlinkage with the new measures of the programme of measures**
1. Estonian shipping is internationally competitive	The measures of the programme of measures have no direct link to the objective of the Estonian Marine Policy Development Plan.
2. Increased trade flows through Estonian harbours	The new measures of the programme of measures have no direct link to the objective of the Estonian Marine Policy Development Plan.
3. Increased number of passengers on international shipping lines	The new measures of the programme of measures have no direct link to the objective of the Estonian Marine Policy Development Plan.

Objectives	Interlinkage with the new measures of the programme of measures
4. Estonian shipbuilding and repair are internationally competitive	The measures of the programme of measures have no direct link to the objective of the Estonian Marine Policy Development Plan.
5. The safety and security in vessel traffic and ports has improved	• Improving the efficiency of marine pollution prevention capacity to respond to environmental emergencies at sea. • Control of environmental risks that accompany bunkering operations at sea. • Reduction of disposal of untreated wastewater into the sea, including ensuring reception of wastewater from cruise ships in ports. • Organisation in ports a common marine litter reception system.
6. The state of the marine environment has improved	Implementation of the plan of measures is part of the developing and implementing process of the Marine Strategy to improve the status of the marine environment.
7. The state of the marine environment has improved	• Developing regional aquaculture plans to control a possible environmental pressure • Ratification of the international Ballast Water Management Convention (BWMC), facilitation of implementation by participation in the regional information system and its implementation. • Developing regional fishing restrictions and updating limit sizes of commercial fish. • Adjusting catching capacity to meet the conditions of good environmental status. • Adopting restrictions on ship traffic in case of wave exposure impact. • Improving the efficiency of marine pollution prevention capacity to respond to environmental emergencies at sea. • Improving the marking system of fishing gear for better control and prevention of abandoning fishing gear. • Organisation in ports a common marine litter reception system.
8. Estonian education system provides modern training in balanced volume of specialists necessary for all fields of the marine sector	• Awareness building about non-indigenous species to control their invasion.
9. The quantity and quality of Estonian marine research have increased	• Developing regional aquaculture plans to control a possible environmental pressure. • Developing regional fishing restrictions and updating limit sizes of commercial fish. • Adjusting catching capacity to meet the conditions of good environmental status.

Objectives	Interlinkage with the new measures of the programme of measures
10. Marine tourism and marine and coastal business activities are developed	The new measures of the programme of measures have no direct link to the objective of the Estonian Marine Policy Development Plan.
11. The preservation of marine cultural heritage and traditions is secured	The new measures of the programme of measures have no direct link to the objective of the Estonian Marine Policy Development Plan.

National Transport Development Plan 2014–2020

The National Transport Development Plan for 2014–2020 is a document that outlines the development fields of the sector. It was approved by the *Riigikogu* on 19 February 2014. The general objective of Estonian transport system is to enable movement of people and goods in accessible, convenient, quick, safe and sustainable way.

The Development Plan sets seven sub-objectives that measures will be set for their implementation.

Sub-objective 1. Convenient and smart movement environment
- Measure 1.1. Replacement of forced movement.
- Measure 1.2. Reduction of forced movement.
- Measure 1.3. Preference of sustainable method of movement.
- Measure 1.4. Development of intelligent transport systems.

Sub-objective 2. High-quality roads and smooth traffic
- Measure 2.1. Specification of distribution of roads and ensuring financing of road management work.
- Measure 2.2. Improvement of the state of roads.
- Measure 2.3. Improvement of traffic management.

Sub-objective 3. Reduction of traffic damages
- Measure 3.1. Improving traffic safety.

Sub-objective 4. Reduction of environmental impacts of transport
- Measure 4.1. Facilitation of use of renewable fuels in road transport.
- Measure 4.2. Improving the economy of the car fleet.

Sub-objective 5. Convenient and modern public transport
- Measure 5.1. Development of national public transport connections.
- Measure 5.2. Development of regional public transport connections.
- Measure 5.3. Development of local public transport connections.
- Measure 5.4. Integration of public transport and improving access.

Sub objective 6. International travel connections that support tourism and business
- Measure 6.1. Development of air connections.
- Measure 6.2. Development of ship connections.
- Measure 6.3. Development of road connections.

- Measure 6.4. Development of passenger train connections.

Sub-objective 7. The volume of international carriage of goods has increased

- Measure 7.1. Development of infrastructure required for carriage of goods.
- Measure 7.2. Development of legal environment that facilitates international transport.

The new measures of the programme of measures do not have a direct link to the objectives of the National Transport Development Plan. There are indirect links to the development of ship connections and necessary infrastructure for carriage of good with new measures of the programme of measures:

- Promotion of use of liquefied natural gas (LNG) as ship fuel.
- Reduction of disposal of untreated wastewater into the sea, including ensuring reception of wastewater from cruise ships in ports.
- Control of environmental risks that accompany bunkering operations at sea.
- Organisation at ports a common marine litter reception system.

Estonian Aquaculture Strategy 2014–2020

Seven main directions are outlined in the Estonian Aquaculture Development Strategy 2014–2020 and necessary key activities to achieve success (Table 4.11):

1. To achieve higher productivity, competitive price and stable quality:
    - Investments that strengthen competitiveness into technologies and solutions that improve efficiency and quality of production.
    - Investments into prevention of fish and crayfish diseases and control of predators (wellbeing of fish and crayfish).
    - Mapping of regions suitable for offshore aquaculture, testing and investments into production, if they are suitable.
    - Investments into the establishment and expansion of farms for growing species that suit into Estonian conditions.
    - Investments into support activities that support aquaculture (create synergy) and development of infrastructures.
    - Investments that help sustain the environment.

2. To use home market advantage:
    - Development of “Prefer local fresh fish” marketing messages and an action plan, image building of the aquaculture sector.
    - Promotion of sale of fresh fish.
    - Finding/creating new marketing possibilities. Implementation of marketing and awareness building campaigns of aquaculture products targeted at home market.
    - Analysis of organic products market and development of products that meet the demand.

3. To develop cooperation and strategic partnership between aquaculture farmers:
    - Assembly of companies through a producer organisation (also through producer organisation associations) to achieve a better position for negotiations and synergy (bigger volumes, stability of procurements, uniform quality, product development, production and common marketing).

- Joint activity through professional associations to represent common interests and implement strategy in cooperation with other stakeholders groups.
- Partnership with representatives of employees, trade organisations (also international) and other sectors.

4. To develop higher value-added and differentiated products:
    - Development of competitive business models and processes and implementation thereof (for example, fast and flexible solutions in the supply chain, direct marketing and sales, specialisation and cooperation in the name of a better outcome).
    - Innovation for the development and launching of products that are distinguishable on the market. Cooperation with research and development institutions when developing higher value added products.

5. Cultivation of species that suit to the Estonian natural conditions and have a high demand abroad and more intensive research and development work that supports it:
    - Supporting of development of farming technologies of species that suit into Estonian conditions (research, testing, investments).
    - Study of conditions and profitability of export markets for perspective species that are already farmed in Estonia (eel, crayfish, sturgeon, pollen etc.) and target programmes to enter these markets.

6. To enhance supportive business environment:
    - Development and implementation of suitable financing and insurance schemes.
    - Changing environment management systems so that the system supports international competitiveness.
    - Creation of operational veterinary services and appropriate legislation (including purchase of veterinary services until the development of a domestic system and competences).
    - Improving importing and availability of veterinary medicinal products.
    - Improving administrative procedures so that they are faster and more efficient (including in the offshore aquaculture sector).
    - Development of nature damage compensation mechanisms and implementation thereof as in neighbouring countries.
    - Development and implementation of measures that would restrict marketing of poor quality aquaculture products.

7. To acquire sector-specific and business knowledge and skills:
    - Ensuring availability of specialised information and the best international practice, development of a consultancy system and training of skilled workers and creation of in-service system.
    - Linking training, research and development work with the current and future needs of people involved in aquaculture.
    - Strategy and business training of people already involved in aquaculture or those that begin their operations.

Table 4.11. Interlinkage of measures of the programme of measures with the objectives of the Estonian Aquaculture Sector Development Strategy for 2014–2020

Objectives	Interlinkage with the measures of the programme of measures
1. To achieve higher productivity, competitive price and stable quality	• Developing regional aquaculture plans to control a possible environmental pressure.
2. To use home market advantage	The new measures of the programme of measures do not have a direct link to the objective of the Estonian Aquaculture Sector Development Strategy.
3. To develop cooperation and strategic partnership between aquaculture farmers	The new measures of the programme of measures do not have a direct link to the objective of the Estonian Aquaculture Sector Development Strategy.
4. To develop higher value-added and differentiated products	The new measures of the programme of measures do not have a direct link to the objective of the Estonian Aquaculture Sector Development Strategy.
5. Cultivation of species that suit to the Estonian natural conditions and high foreign demand and intensifying research and development work that supports it	• Developing regional aquaculture plans to control a possible environmental pressure.
6. To enhance aquaculture supportive business environment	The new measures of the programme of measures do not have a direct link to the objective of the Estonian Aquaculture Sector Development Strategy.
7. To acquire sector-specific and business knowledge and skills	The new measures of the programme of measures do not have a direct link to the objective of the Estonian Aquaculture Sector Development Strategy.

Recreational Fishing Development Plan for 2010–2013 (with the perspective until 2018)

The Development Plan specified for 2010–2013 (perspectively until 2018) the development fields and preferred activity in recreational fishing. The strategic objective of the Development Plan is to popularise, simplify and diversify recreational fishing as a healthy activity to spend free time and sustainable use of the environment and increase thereby the number of fishers to one hundred thousand that are involved in recreational fishing that helps sustain fish stock in 2018.

In order to achieve the general strategic objective, it is necessary to set and achieve the following sub-objects (Table 4.12):

Table 4.12. Interlinkage of the measures of the programme of measures with the objectives of the Recreational Fishing Development Plan for 2010–2013 (perspectively 2018)

Objective	**Interlinkage with the measures of the programme of measures**
1. Improving and simplifying access to recreation fishing	The new measures of the programme of measures have no direct link to the objective of the Recreational Fishing Development Plan.
2. Preservation of diversity of recreational fishing tackle	The new measures of the programme of measures have no direct link to the objective of the Recreational Fishing Development Plan.
3. Defining and harmonisation of use of recreational fishing tackle	• Developing regional fishing restrictions and updating limit sizes of commercial fish. • Improving the marking system of fishing gear for better control and prevention of abandoning fishing gear.
4. Popularisation of recreational fishing and dissemination sector-related information and work with the public	• Improving the marking system of fishing gear for better control and prevention of abandoning fishing gear. • Preparing an action plan to improve control over fishing gear and clean the sea of abandoned fishing gear. • Preparing and implementing action plans of local authorities in coastal regions to prevent and reduce marine litter.
5. Development of joint activity and involving fishers in the decision processes	The new measures of the programme of measures have no direct link to the objective of the Recreational Fishing Development Plan.
6. Development of infrastructure that supports recreational fishing	• Organisation at ports a common marine litter reception system.
7. Development of sustainable recreational fishing	• Developing regional fishing restrictions and updating limit sizes of commercial fish.
8. Development of fishing tourism	• Developing regional fishing restrictions and updating limit sizes of commercial fish. • Promotion of realisation of low-value fish. • Adjusting catching capacity to meet the conditions of good environmental status. • Improving the marking system of fishing gear for better control and prevention of abandoning fishing gear.
9. Analysis and gathering of data on the recreational fishing sector	The new measures of the programme of measures have no direct link to the objective of the Recreational Fishing Development Plan.
10. Reproduction of fish stocks	• Developing regional fishing restrictions and updating limit sizes of commercial fish. • Adjusting catching capacity to meet the conditions of good environmental status.

County planning of the marine areas bordering Hiiu County (not adopted)

The objective of the planning is to ensure fulfilment of the spatial development objectives of Hiiu County marine area by participative planning process. The planning sets out various uses of the marine area and has determined the principles and directions of spatial development.

The new measures of the programme of measures have no direct link to the county planning of the marine areas bordering Hiiu County.

County planning of the marine areas bordering Pärnu County (not adopted)

The objective of preparing the county planning of the marine area bordering Pärnu County is to determine during the public planning process the use of marine area that is bordering Pärnu County that takes into account in a balanced way all different interests. An important outcome of the marine area spatial planning is prevention or minimizing conflicts of activities performed or planned to be performed at sea and the use of sea and the nature.

The new measures of the programme of measures have no direct link to the county planning of the marine areas bordering Pärnu County.

Water Management Plans for western Estonia, eastern Estonia and Koiva basins for 2015–2021

A water management plan is a strategic document that is prepared to plan measures for the protection and use of surface and groundwater. Two principles are the basis for setting objectives of a water management plan:

- good status of water bodies must be maintained;
- water bodies not in good condition must be brought into a good condition.

The general objective of the new water management period is to achieve by 2021 good condition of waterbodies that are not presently in this condition.

The objective of the measures developed with the Estonian Marine Strategy`s programme of measures to achieve and maintain good environmental status of the Estonian marine area is to improve the environmental condition of the marine area and achieve good environmental status. The programmes of measures of water management plans set down measures for the use and protection of surface and ground water that help improve and maintain the environmental condition of the marine area.

The new measures included in the programme of measures are not in conflict with the objectives set down in Estonian national documents.

5. ENVIRONMENTAL IMPACTS EXPECTED TO OCCUR DURING IMPLEMENTATION OF THE PROGRAMME OF MEASURES AND THEIR MITIGATION MEASURES

5.1 Analysis of the impact of implementation of the Estonian Marine Strategy`s programme of measures

This chapter analyses the area-specific impact during the implementation of the Estonian Marine Strategy`s programme of measures. Impacts are assessed by measures set out in the programme of measures, giving additionally a total score to the descriptive part. The following scale is used to give the total score:

+ positive impact;
- negative impact;
0 no impact;
? impact is unclear or unknown.

After the score given in **Table 5.1**, area-specific summaries of the impact assessment have been presented and, if necessary, recommendations/proposals have been made on measures/topics that must be taken into account when developing the programme of measures further.

Table 5.1. Assessment of impact on the natural environment of the Estonian Marine Strategy`s programme of measures

	SEA area	Impact on marine biota and habitats (including impact on protected nature objects)		Impact on seawater quality and physical indicators of the marine environment		Impact on air quality and climate changes (including outdoor noise)		Impact on the sustainable use of natural resources and resources	
No.	Measure	Description of impact	S	Description of impact	S	Description of impact	S	Description of impact	S
1.	Establishing a marine protection areas network in Estonia`s economic zone.	According to the available data, it is difficult to give an assessment on the impact of the measure, because the information about valuable nature objects in the economic zone (habitats etc.) and their protection needs is deficient. Implementation of the measure may bring about a positive impact if with research has been proved that there exist valuable nature objects in the economic zone and if their protection is not sufficiently ensured with the network of protection areas in Estonia and other protective measures. It can be presumed that the negative impact of pressures on neighbouring areas of the protection areas will increase. Overall impact on	?/ +	The measure may potentially bring about a positive impact. A significant positive impact may be prevention of certain development works in the protected marine areas (excavation, dumping, erecting of windfarms and establishing offshore fish farms). This would reduce/prevent several important pressures on <u>this marine area</u>: sealing, smothering, siltation, abrasion, underwater noise, change in thermohalinic regime, inputs of substances into the sea. It can be presumed that the negative impact on the neighbouring areas of similar future protected areas with similar environmental conditions will increase. Overall impact on the Estonian marine area is positive. To create a	+	Taking into account the location of the economic zone and the nature of measures, a significant impact is not expected.	0	When marine protection areas are established in Estonia`s economic zone, several restrictions will be imposed on excavation on protected areas, erecting of windfarms and development of aquaculture that hinder use of natural resources on these areas. However, establishment of protection areas ensures maintenance of biodiversity that is in accordance with the sustainable development principle.	0

	SEA area	Impact on marine biota and habitats (including impact on protected nature objects)		Impact on seawater quality and physical indicators of the marine environment		Impact on air quality and climate changes (including outdoor noise)		Impact on the sustainable use of natural resources and resources	
No.	Measure	Description of impact	S	Description of impact	S	Description of impact	S	Description of impact	S
		the Estonian marine area is positive.		maximum positive impact and reduce negative impact, it is necessary when selecting the location of the future protected areas to perform a detailed (risk) analysis, taking into account also neighbouring marine areas.					
2.	Adoption and implementation of the ringed seal protection plan.	The measure has a positive impact on ringed seals that belong to protection category II. Ringed seals are protected to increase and maintain the population of the species and to increase their range by necessary activities (reduction of pressures, improving food base, conservation of habitats and establishment of protected areas for this purpose) that has also a positive impact on the habitats that fish and birds need.	+	The measure may potentially bring about a positive impact. A significant positive impact may be prevention of certain developments on the protected marine areas (excavation, dumping, erection of windfarms and establishment of offshore fish farms). This would reduce/prevent several important pressures on this marine area: sealing, smothering, siltation, abrasion, underwater noise, change in thermohalinic regime, inputs of substances	+	No significant impact.	0	A certain negative impact may occur, because of restrictions that hinder extraction of earth resources, establishment of windfarms or development of aquaculture.	-

	SEA area	Impact on marine biota and habitats (including impact on protected nature objects)		Impact on seawater quality and physical indicators of the marine environment		Impact on air quality and climate changes (including outdoor noise)		Impact on the sustainable use of natural resources and resources	
No.	Measure	Description of impact	S	Description of impact	S	Description of impact	S	Description of impact	S
				into the sea. It can be presumed that the negative impact of pressures on the neighbouring areas of the future protected areas with similar environmental conditions will increase. Overall impact on the Estonian marine area is positive. To create a maximum positive impact and reduce the negative impact, it is necessary when selecting the location of the future protected areas to perform a detailed (risk) analysis, taking into account also neighbouring marine areas.					
3.	Developing regional aquaculture plans to control a possible environmental pressure.	Implementation of the measure has a positive preventive impact on the marine biota and habitats. The measure helps prevent and avoid loss of natural habitats and decline of their condition and occurrence of	+	The measure has a positive preventive impact on inputs of substances into the sea and water quality. The measure enables to reduce the potential environmental impact due to aquaculture and analyse potential	+	Aquaculture-related air pollution is primarily local and related to operating of aquaculture grounds (e.g. servicing ship traffic, production facilities on land). The impact on air quality and climate may be generally	0/?	Implementation of the measure has a positive impact on the sustainable development of aquaculture. Taking into account the fact that in the eutrophication of the Baltic Sea, aquaculture that is nutrient neutral or	+

	SEA area	Impact on marine biota and habitats (including impact on protected nature objects)		Impact on seawater quality and physical indicators of the marine environment		Impact on air quality and climate changes (including outdoor noise)		Impact on the sustainable use of natural resources and resources	
No.	Measure	Description of impact	S	Description of impact	S	Description of impact	S	Description of impact	S
		pressures (added nutrients, non-indigenous species etc.) by planning efficient aquaculture that takes into account the natural environment.		problems that are caused in relation to it. Taking into account he fact that in the eutrophication of the Baltic Sea, aquaculture that takes nutrients out of the marine environment (nutrient negative) has a positive impact. The scope of impact will be identified during implementation of the programmes.		considered insignificant, but it depends on the production volumes. An indirect impact may be related to the fact that the measure foresees development of offshore aquaculture regionally. This may also improve e.g. optimisation of service boat traffic and thereby reduce air pollution.		that takes nutrients out of the marine environment (nutrient negative) must be preferred and the positive impact is achieved thereby that the production of a new resource contributes to the improvement of the environmental condition of seawater (this is a sustainable use of resources).	
4.	Awareness building about non-indigenous species to control their invasion.	No direct impact on the natural environment. An indirect positive impact is expected presumably through improving the general environmental awareness of the public about the invasion of non-indigenous species, its consequences and invasion	0/+	No direct impact, but building environmental awareness of people in a specific area presumably improves the general attitude towards the marine environment.	0	No direct impact.	0	No direct impact. An indirect positive impact on the commercial fish stocks and algae by building environmental awareness about invasion of non-indigenous species and its consequences that may damage the mentioned resources.	0/+

	SEA area	Impact on marine biota and habitats (including impact on protected nature objects)		Impact on seawater quality and physical indicators of the marine environment		Impact on air quality and climate changes (including outdoor noise)		Impact on the sustainable use of natural resources and resources	
No.	Measure	Description of impact	S	Description of impact	S	Description of impact	S	Description of impact	S
		prevention and mitigation measures.							
5.	Ratification of international Ballast Water Management Convention (BWMC), facilitation of implementation by participation in the regional information system and its implementation.	Implementation of the measure has a positive impact on the habitats and marine biota because the measure is intended to reduce the invasion risk of new non-indigenous species and restrict transfer thereof with ballast water.	+	Input of ballast water to the sea does not have known impacts on water quality reduction and changes in physical indicators other than local impacts.	0	No significant impact.	0	No direct impact. Implementation of the measure has an indirect positive impact because it is intended to reduce the invasion risk of new non-indigenous species and restrict transfer thereof with ballast water and thus enables to reduce damaging of commercial fish and algae due to non-indigenous species.	0/ +
6.	Developing regional fishing restrictions and updating limit sizes of	The impact is positive. The measure helps improve knowledge about the actual situation of commercial fish populations, identify fish populations that required implementation of more effective measures and	+	No direct impact. Theoretically, there may occur some local impacts on the circulation of substances due to influencing the top of the marine environment food chain (fisheries), but this	0	No direct impact. An indirect impact is related to the development of fishing restrictions that may reduce the interest of professional	0	If the measure has a positive impact on the sustainable use of natural resources, then it will influence the populations of commercial fish species and their reproduction.	+

	SEA area	Impact on marine biota and habitats (including impact on protected nature objects)		Impact on seawater quality and physical indicators of the marine environment		Impact on air quality and climate changes (including outdoor noise)		Impact on the sustainable use of natural resources and resources	
No.	Measure	Description of impact	S	Description of impact	S	Description of impact	S	Description of impact	S
	commercial fish.	assess effectiveness of current limits. Imposing fishing limits may help improve reproduction capacity of fish populations and reduce the load on fish populations due to fishing. An indirect positive impact on birds and mammals that feed on fish is expected to be seen years after implementation of the measures.		impact is marginal in the context of natural variety.		fishermen in fishing. This will result in reduction in air pollution originating from ships and boats. However, changing limit sizes of commercial fish may create a need for a larger number of trips to the sea to get the catch. Anyway, the said impacts on air quality are marginal compared to air pollution caused by cargo and passenger ships.			
7.	Promotion of realisation of low-value fish.	The measure has a positive impact on fisheries, because discards has been an important pressure on young fish. The measure may reduce the pressure of non-indigenous species, improve knowledge about valuable fish catches.	+	No direct impact. The measure reduces the pressure due to fishing on fish populations that indirectly through the food chain influences the circulation of substances, but this impact is marginal against the natural variety.	0	No significant impact.	0	The measure facilitates using low-value fish that has been caught during commercial fishing operations and it has a positive impact in terms of sustainable use of fish stocks.	+

	SEA area	Impact on marine biota and habitats (including impact on protected nature objects)		Impact on seawater quality and physical indicators of the marine environment		Impact on air quality and climate changes (including outdoor noise)		Impact on the sustainable use of natural resources and resources	
No.	Measure	Description of impact	S	Description of impact	S	Description of impact	S	Description of impact	S
8.	Adjusting catching capacity to meet the conditions of good environmental status.	Imposition of fishing limits may help improve reproduction capability of fish populations and reduce the load on fish populations caused by fishing activities.	+	No direct impact. The measure changes the pressure on fish populations due to fishing that indirectly through the food chain influences the circulation of substances, but this impact is marginal against the natural variety.	0	Implementation of the measure has an indirect positive impact, because the number of ships and frequency of trips and their length made by fishermen depend on fishing capacity that in turn has an impact on air quality. It is presumed that by optimising catching capacity, it is possible to reduce air pollution caused by using the fishing fleet.	+	Restricting catching capacity influences positively the reproduction of commercial fish species that is a positive aspect in terms of sustainable use of natural resources.	+
9.	Promotion of use of liquefied natural gas (LNG) as ship fuel.	The measure may have an indirect positive impact on the marine environment due to reduction of nitrogen inputs.	+	The measure has a positive impact on water quality. Smaller concentrations of exhaust gases cause reduction in nitrogen inputs to the Baltic Sea that should reduce eutrophication.	+	The measure has a positive impact on air quality and climate changes. For example, the volume of exhaust gases will significantly drop when LNG-ships are taken into use compared to traditional liquid fuels (SO_x - 99%; NO_x - 90%; CO_2 - 25%; PM - 99%) and saving of fuels will increase.	+	The measure has a positive impact on water quality and thereby on commercial fish and algae resource. LNG ship fuel has a bigger energy value per unit mass compared to diesel fuel, making it more efficient in terms of resource use. A negative impact is the need to reconstruct already existing ships or build new ships that use LNG as ship	+/-

	SEA area	Impact on marine biota and habitats (including impact on protected nature objects)		Impact on seawater quality and physical indicators of the marine environment		Impact on air quality and climate changes (including outdoor noise)		Impact on the sustainable use of natural resources and resources	
No.	Measure	Description of impact	S	Description of impact	S	Description of impact	S	Description of impact	S
								fuel that also means using of natural resources.	
10.	Reduction of disposal of untreated wastewater into the sea, including ensuring reception of wastewater from cruise ships in ports.	The measure has a positive impact on the habitats, marine biota and protected areas, because is helps reduce pressures (marine litter, organics, pollutants).	+	The measure has a positive impact on water quality. The measure reduces marine transport pollution pressure on the marine environment. There is a positive impact on marine litter, content of hazardous substances and nutrient concentrations and eutrophication.	+	No direct impact. Indirect impacts are related to further treatment of wastewater received from ships in on-land treatment facilities. It may be expected that treatment is organised in accordance with current norms which means that no significant air pollution is foreseen due to such treatment.	0	The measure enables to reduce marine pollution caused by non-compliant treatment of wastewater that may damage algae and commercial fish stocks.	+
11.	Additional nutrient, hazardous substance and litter inflow reductions from stormwater directly to the sea – the	The measure has a positive impact on the habitats, marine biota and protected areas because it helps reduce pressures (marine litter, organics, pollutants).	+	The measure has a positive impact on water quality. The measure reduces the pressure of land-based pollution on the marine environment. There is a positive impact on reduction of marine litter, content of	+	No significant impact.	0	The measure enables reducing organic matter (including petrol products), nitrogen, phosphorous, synthetic and bioactive substances, microbiological contamination and input of litter with stormwater	+

	SEA area	Impact on marine biota and habitats (including impact on protected nature objects)		Impact on seawater quality and physical indicators of the marine environment		Impact on air quality and climate changes (including outdoor noise)		Impact on the sustainable use of natural resources and resources	
No.	Measure	Description of impact	S	Description of impact	S	Description of impact	S	Description of impact	S
	construction of stormwater sewerage and treatment systems.			hazardous substances and nutrient concentrations and eutrophication and inputs of organic substances (including petrol products) to the sea from land.				to the sea from land that improves seawater quality and reduces damages to algae and commercial fish stocks.	
12.	Establishing restrictions on ship traffic in case of wave exposure impact.	The measure may potentially bring about a positive impact in regions where waves created by high-speed craft is a problem for the coastal abrasion processes and habitats. Some restrictions have already been imposed in Väinameri special conservation area. It is difficult to assess the impact on the available data.	+/?	A positive impact may be alleviation of coast abrasion processes, but the extent of this positive impact is not clear.	+/?	Limiting speed of ships near coast has a positive impact on the region`s air quality because speed is the one factor that influences directly the amounts of emitted pollutants. On the other hand, ship owners (especially on regular lines) may have to overcome the lost time on the open sea and therefore move at higher speeds. Consequently, the entire route of the ship`s aggregate impact on air quality may stay similar compared to the situation	+/?	No significant impact.	0

	SEA area	Impact on marine biota and habitats (including impact on protected nature objects)		Impact on seawater quality and physical indicators of the marine environment		Impact on air quality and climate changes (including outdoor noise)		Impact on the sustainable use of natural resources and resources	
No.	Measure	Description of impact	S	Description of impact	S	Description of impact	S	Description of impact	S
						when speed is not limited in the coastal sea.			
13.	Improving the efficiency of marine pollution prevention capacity to respond to environmental emergencies at sea.	The measure helps improve detection capacity of oil pollution and ensures faster and more professional response and thereby reduces negative impacts associated with oil pollution (loss of habitats, loss of birds, fish and benthic biota, deformations etc.) on the habitats, marine biota and protected areas.	+	The measure has a positive impact. More efficient capacity of pollution prevention helps reduce the amounts of hazardous substances (including oil products) and thereby the impact caused to the marine environment.	+	The measure has a positive impact on air quality because improving the readiness to respond to marine pollution means improved speed of detection of air pollution (e.g. fires on ships etc.) and liquidation of causes.	+	No direct impact. By making marine pollution control capacity more efficient, the amount of hazardous substances (including oil products) and thereby the impact on the algae and commercial fish stocks will be reduced.	0/ +
14.	Control of environmental risks that accompany bunkering operations at sea.	The measure helps reduce the number of oil pollution incidents and thereby negative impacts caused by oil pollution (loss of habitats, loss of birds, fish and benthic biota, deformations etc.) on the habitats, marine biota and protected areas.	+	The measure has a positive impact. The measure reduces the likelihood of accidents and oil pollution risks.	+	Implementation of the measure has an indirect positive impact on air quality because by specification of bunkering requirements it is possible to reduce the number of potential accidents and accompanying risks of air pollution.	+	No direct impact. The measure helps reduce the likelihood of oil pollution incidents and thereby damage to algae and commercial fish stocks.	0/ +
15.	Improving the marking	Implementation of the measure is expected to have	+	The measure has a positive impact. It helps reduce the	+	No significant impact.	0	As the measure helps reduce fishing pressure on	+

	SEA area	Impact on marine biota and habitats (including impact on protected nature objects)		Impact on seawater quality and physical indicators of the marine environment		Impact on air quality and climate changes (including outdoor noise)		Impact on the sustainable use of natural resources and resources	
No.	Measure	Description of impact	S	Description of impact	S	Description of impact	S	Description of impact	S
	system of fishing gear for better control and prevention of abandoning fishing gear.	a positive impact because the measure helps reduce the pressure on fish populations that in turn has a positive impact on the marine animals that feed on fish. Reduction of marine litter (fishing gear) has a positive effect on the benthos, because abandoned and lost fishing gear may cause death of marine organisms.		amount of litter inputs into the sea.				commercial fish populations and supports maintenance of fish populations which means that the measure has a positive impact on the sustainable use of natural resources.	
16.	Preparing an action plan to improve control over fishing gear and clean the sea of abandoned fishing gear.	A positive impact is expected from the implementation of the measure because it helps reduce the pressure caused by abandoned fishing gear on the marine biota (especially on seals, fish, birds).	+	The measure has a positive impact. The measure helps reduce the amount of litter inputs into the sea.	+	No significant impact.	0	As the measure helps reduce, among other things, the pressure of abandoned fishing gear on commercial fish populations and supports maintenance of fish populations, it has a positive impact on the sustainable use of naturel resources.	+

	SEA area	Impact on marine biota and habitats (including impact on protected nature objects)		Impact on seawater quality and physical indicators of the marine environment		Impact on air quality and climate changes (including outdoor noise)		Impact on the sustainable use of natural resources and resources	
No.	Measure	Description of impact	S	Description of impact	S	Description of impact	S	Description of impact	S
17.	Prevention of the marine littering problem and organisation of awareness building environmental educational events and cleaning sprees.	Implementation of the measure is expected to have a positive impact because it helps improve the awareness of people about marine litter and related problems and risks. The long-term objective is that along with reduction of marine litter, there will be a reduced pressure on the marine biota.	+	The measure has a positive impact. The measure helps reduce the amount of litter inputs into the sea.	+	No significant impact.	0	As the measure helps reduce, among other things, the pressure of abandoned fishing gear on commercial fish populations and supports maintenance of fish populations, it has a positive impact on the sustainable use of naturel resources. The measure helps also indirectly to gather litter that is input into the sea currently and creates prerequisites for recycling of at least part of this waste which has a positive impact in terms of sustainable resource use.	+
18.	Reducing the use of plastic bags, supporting relevant publicity and educational activities.	It is expected to have a positive impact on the marine biota because implementation of the measure helps to reduce the use of plastic bags and it is expected to reduce the amounts of plastic inflows into the sea.	+	The measure has a potential to have a positive impact. The measure helps reduce the amount of litter inputs into the sea.	+	No significant impact.	0	No direct impact but it is possible to reduce the use of plastic bags through informative campaigns and educational activities and thereby their production, saving so non-renewable natural resources.	+

	SEA area	Impact on marine biota and habitats (including impact on protected nature objects)		Impact on seawater quality and physical indicators of the marine environment		Impact on air quality and climate changes (including outdoor noise)		Impact on the sustainable use of natural resources and resources	
No.	Measure	Description of impact	S	Description of impact	S	Description of impact	S	Description of impact	S
19.	Preparing and implementing action plans of local authorities in coastal regions to prevent and reduce marine litter.	The implementation of the measure has a potential indirect positive impact on the marine biota and the protected areas, because helps prevent and reduced the inflow of litter into the sea.	+	The measure has a positive impact. The measure helps reduce the amount of litter inputs into the sea.	+	No significant impact.	0	No direct impact. The measure helps also indirectly to collect litter that is input into the sea currently and creates prerequisites for recycling of at least part of this waste that has a positive impact in terms of sustainable resource use.	+
20.	Organisation in ports a common marine litter reception system.	Implementation of the measure has a potential positive impact on the marine biota and protected areas because helps prevent and reduce the amount of litter inputs into the sea.	+	The measure has a positive impact. The measure helps reduce the amount of litter inputs into the sea.	+	No significant impact.	0	No direct impact. An indirect positive impact because the reception system of marine litter enables direct waste into recycling, saving thus natural resources.	+
21.	Establishing an impulsive sound register.	No direct impact. Implementation of the measure may have a positive impact in future on the marine biota because gathering information on the underwater noise and establishment of the register helps identify hazardous noise sources that are	?/ +	Underwater noise and its impact on the marine environment in our region is not well researched topic in our region. Establishment of an impulsive sound register enables to determine more precisely the importance of its anthropogenic impact and if necessary take additional	+	The measure is related to identification of underwater noise and is not directly related to outdoor noise. In many cases an activity that causes underwater noise also causes noise that travels outdoors (e.g. pile-driving	0/ +	Establishment of the register helps improve awareness about underwater noise that may bring about imposition of restrictions on extraction and establishment of wind generators in the regions where are mineral deposits or where marine windfarm areas are planned. On the	0

	SEA area	Impact on marine biota and habitats (including impact on protected nature objects)		Impact on seawater quality and physical indicators of the marine environment		Impact on air quality and climate changes (including outdoor noise)		Impact on the sustainable use of natural resources and resources	
No.	Measure	Description of impact	S	Description of impact	S	Description of impact	S	Description of impact	S
		important for the marine biota and assess the frequency of hazardous noise events in the region and, if necessary, implement in the future underwater noise mitigation measures, e.g. acitivites by location.		environment protection measures.		when waterwalls are constructed etc.) that has an impact on the sea and coastal biota (e.g. birds) as well as people that live on the coast. Consequently, it is necessary along with mapping underwater noise also to map noise that travels in the air caused by the same sources. This allows to gather comprehensive information about the marine environment related noise sources.		other hand, establishment of the register may disperse doubts about the impact of underwater noise on the biota.	

Table 5.1 continued. Assessment of the impact of the programme of measures on the socio-economic environment

	SEA area	Impact on well-being and health of humans (including outdoor noise)		Impact on marine business environment (including fisheries, aquaculture, tourism etc.)		Impact on marine transport and ports (including traffic safety and security)		Impact on marine cultural heritage	
No.	Measure	Description of impact	S	Description of impact	S	Description of impact	S	Description of impact	S
1.	Establishing a marine protection areas	Taking into account the location of the economic zone and the nature of the	0	Establishment of marine protection areas in the economic zone may have a	?	The measure is planned in the economic zone where is an important eastern and western	-/?	By studying the marine environment valuables in the economic zone and	+

	SEA area	Impact on well-being and health of humans (including outdoor noise)		Impact on marine business environment (including fisheries, aquaculture, tourism etc.)		Impact on marine transport and ports (including traffic safety and security)		Impact on marine cultural heritage	
No.	Measure	Description of impact	S	Description of impact	S	Description of impact	S	Description of impact	S
	network in Estonia`s economic zone.	measure, no significant impact is foreseen. An indirect negative impact may be caused due to potential imposing of movement restrictions on traffic in the protected areas that may have a negative impact mainly on the well-being of people involved in water tourism. However, taking into account the location of the economic zone, the impact may be considered insignificant.		negative impact on fisheries (primarily trawling) and companies related to offshore windfarms development. The impact is related to the potential overlapping of the protection areas with the areas suitable for fishing or wind energy development. As the precise locations of the protected areas are not currently known, the impact and its significance cannot be determined more precisely.		international waterway. A potential negative impact may be caused by imposing restrictions on traffic in the waters of the protected areas. It may still be expected that overlapping of the protection areas and the waterway is minimal because the main valuable areas are in shallower parts of the sea where there is no frequent traffic.		establishing potential protection areas may lead to a positive impact due to finding potential new valuable objects.	
2.	Adoption and implementation of the ringed seal protection plan.	A certain negative impact may be caused when restrictions on the movement of vessels near the habitats of ringed seals are imposed. As the main habitats are on the banks and inlets in the region of Väinameri and the Gulf of Riga, most	-	A certain impact may be present primarily for the companies involved in tourism due to potential additional restriction on movement near the permanent habitats of the ringed seal. It may be presumed that the impact is	-/0	The main waterways and ports are located away from the ringed seal resting grounds. Possible negative impacts may be caused primarily on the coastal traffic (mainly in Väinameri region) and this in case if movement of vessels is restricted near ringed seal	-/0	Sealing may be considered part of marine cultural heritage. Sealing was forbidden for decades but now hunting grey seals is allowed to certain extent. As the abundance of the ringed seal is small, they are not allowed to be hunted. At the	+

	SEA area	Impact on well-being and health of humans (including outdoor noise)		Impact on marine business environment (including fisheries, aquaculture, tourism etc.)		Impact on marine transport and ports (including traffic safety and security)		Impact on marine cultural heritage	
No.	Measure	Description of impact	S	Description of impact	S	Description of impact	S	Description of impact	S
		influenced are people involved in marine tourism because of restriction of movement.		minimal because the permanent habitat and related restrictions are for the most part already been imposed by now.		habitats (including speed). The extent and significance of the impact depends on the particular situation.		same time, the objective of the measure is maintenance and increasing of the ringed seal population in the Estonian marine area. In long term, the measure has a positive impact on cultural heritage.	
3.	Developing regional aquaculture plans to control a possible environmental pressure.	A positive impact is related to aquaculture as an additional facilitator of development of local food production. Problematic aspects are related to possible air pollution and noise that is caused by movement of the ships that are servicing offshore aquaculture or on-land production. However, air pollution and noise caused by servicing ships may be considered insignificant. Possible air	+/?	The positive impact is related to aquaculture as an additional facilitator of business. On the other hand, aquaculture areas may overlap with the main fishing grounds that may have a negative impact on the companies involved in fisheries and coastal fishermen. At the same time, upon implementation of the measure and when preparing the regional aquaculture plans it is possible to take	+	Currently there are no offshore aquaculture sites in the Estonian waters. This is a new use of the sea which in certain areas has a positive impact due to the use of port services. When establishing new aquaculture sites, it is necessary to take into account traffic areas and thereby the topic of navigation safety. The planned measure foresees preparing of regional plans that enables taking into account the entire situation (including marine transport	+	When developing regional aquaculture plans, it is possible to take into account the existence of cultural valuable objects in the region and avoid damaging the objects when the areas are being developed. In long term, offshore aquaculture practice may become part of marine cultural heritage. Hence, implementation of the measure has a positive impact.	+

	SEA area	Impact on well-being and health of humans (including outdoor noise)		Impact on marine business environment (including fisheries, aquaculture, tourism etc.)		Impact on marine transport and ports (including traffic safety and security)		Impact on marine cultural heritage	
No.	Measure	Description of impact	S	Description of impact	S	Description of impact	S	Description of impact	S
		pollution and noise disturbance from the production facilities depends on the certain location and production capacity. Presumably it has a local and insignificant impact.		into account the fishing grounds´ locations.		and ports). The measure has a positive impact.			
4.	Awareness building about non-indigenous species to control their invasion.	The measure has a positive impact on the well-being and health of humans. Implementation of the measure helps raise the awareness of people whose lives are involved in the sea about non-indigenous species and related risks (including health risks).	+	As shipping is the main cause of non-indigenous species´ invasion, it is important to raise the awareness of people whose lives are involved in the sea about non-indigenous species. The measure has a positive impact.	+	As shipping is the main cause of invasion of non-indigenous species, it is important to raise the awareness of people involved in shipping about non-indigenous species. The measure has a positive impact.	+	An indirect positive impact is primarily related to the fact that non-indigenous species may potentially damage underwater cultural valuable objects.	+
5.	Ratification of international Ballast Water Management Convention (BWMC), facilitation of	A positive impact on the health of people is created via the main objective of the international ballast water convention, which is to control ships ballast water and sediments and by way of	+	Ratification of the BWMC sets additional conditions on the companies involved in shipping. However, e.g. some non-indigenous species (e.g. zebra mussels) may cover underwater parts	-/+	Ratification of the BWMC sets additional conditions on the owners of ships and ports. However, e.g. some non-indigenous species (e.g. zebra mussels) may cover underwater parts of ships and	-/+	An indirect positive impact is related to the fact that non-indigenous species may potentially damage underwater cultural valuable objects.	+

	SEA area	Impact on well-being and health of humans (including outdoor noise)		Impact on marine business environment (including fisheries, aquaculture, tourism etc.)		Impact on marine transport and ports (including traffic safety and security)		Impact on marine cultural heritage	
No.	Measure	Description of impact	S	Description of impact	S	Description of impact	S	Description of impact	S
	implementation by participation in the regional information system and its implementation.	processing avoid, reduce and finally eliminate transfer of dangerous sea organisms and pathogens.		of ships which elimination costs. At the same time, SEI (2011) report has come to the conclusion that the socio-economic impact of the ballast water convention on Estonian society is marginal and the costs to the owners of ships and ports and the state are in acceptable amounts and the benefit of implementation of the measure exceeds significantly the costs.		port infrastructure and their elimination costs. In summary, SEI (2011) report has come to the conclusion that the socio-economic impact of the ballast water convention on Estonian society is marginal and the costs to the owners of ships and ports and the state are in acceptable amounts and the benefit of implementation of the measure exceeds significantly the costs.			
6.	Developing regional fishing restrictions and updating limit sizes of commercial fish.	No significant impact.	0	Implementation of the measure and setting additional fishing restrictions causes a negative impact on the companies involved in fisheries. However, it is a short-term impact and the significant fact is that the main objective of the measure is	-/+	Implementation of the measure may cause a short-term reduction of use of fishing harbours. However, increased abundance of commercial fish populations will contribute to enlivening or maintaining the fisheries sector in long term and thereby use of harbours.	+	Implementation of the measure and setting additional fishing restrictions may cause a negative impact on the coastal fishermen and maintenance of the coastal life-style as an important part of marine cultural heritage. The fact that the	-/+

	SEA area	Impact on well-being and health of humans (including outdoor noise)		Impact on marine business environment (including fisheries, aquaculture, tourism etc.)		Impact on marine transport and ports (including traffic safety and security)		Impact on marine cultural heritage	
No.	Measure	Description of impact	S	Description of impact	S	Description of impact	S	Description of impact	S
				to improve the reproduction capacity of fish populations. Consequently, although the measure may in short term have a negative impact, fishing is not forbidden entirely. The long-term impact is positive because it is presumed that the condition of fish stocks will improve and it is possible to continue with fishing. The next measure will alleviate the short-term impact to certain extent.				main objective of the measure is to improve reproduction capacity of fish populations is important. So, even if the measure may have a negative impact in short term, fishing is not entirely forbidden. The long-term impact is positive because it is presumed that the condition of fish stocks will improve and it is possible to continue with fishing. The next measure will alleviate the short-term impact to certain extent.	
7.	Promotion of realisation of low-value fish.	No significant impact.	0	Implementation of the measure has primarily a positive impact on companies involved in fisheries and processing of fish until implementation of unused potential is facilitated.	+	A certain indirect positive impact may occur in relation to establishment and/or renovation of port infrastructure necessary for the realisation of low-value fish.	+	Implementation of the measure helps maintain fishing as an important part of marine cultural heritage. This helps to certain extent alleviate impact due to imposing of additional fishing restrictions.	+

	SEA area	Impact on well-being and health of humans (including outdoor noise)		Impact on marine business environment (including fisheries, aquaculture, tourism etc.)		Impact on marine transport and ports (including traffic safety and security)		Impact on marine cultural heritage	
No.	Measure	Description of impact	S	Description of impact	S	Description of impact	S	Description of impact	S
8.	Adjusting catching capacity to meet the conditions of good environmental status.	No significant impact.	0	Implementation of the measure has a negative impact on companies involved in fisheries because restricting catching capacity may reduce the number of companies and thereby the number of jobs (professional fishermen, companies involved in processing fish etc.). Mostly are influenced smaller companies. However, in long term impact of the measure is positive (increasing or maintenance of fish populations).	-/+	Adjustment of catching capacity (reduction) may have a negative impact primarily on smaller fishing harbours and their further development. However, in long term, the measure ensures maintenance of fish stocks and thereby the demand for fishing harbours also in future.	-/+	When implementing the measure and reducing catching capacity, a short-term negative impact may occur on coastal fishermen and the maintenance of the coastal lifestyle as an important part of marine cultural heritage. However, it is important that the main objective of the measure is to improve the reproduction capacity of fish populations. Hence, although the measure may have a short term negative impact, fishing is not banned entirely. The long-term impact is positive because it is presumed that the state of fish stocks will improve and coastal fishermen can continue fishing.	-/+

	SEA area	Impact on well-being and health of humans (including outdoor noise)		Impact on marine business environment (including fisheries, aquaculture, tourism etc.)		Impact on marine transport and ports (including traffic safety and security)		Impact on marine cultural heritage	
No.	Measure	Description of impact	S	Description of impact	S	Description of impact	S	Description of impact	S
9.	Promotion of use of liquefied natural gas (LNG) as ship fuel.	The measure has a positive effect on the wellbeing and health of humans through cleaner (compared to traditional liquid fuels) use of ship fuel. People on board of ship and people living near ports are most influenced.	+	Implementation of the measure causes a negative impact and this is due to the fact that to begin using LNG requires significantly large investments and reconstruction of ships or building new ships. Mostly are influenced companies involved in shipping.	-	Implementation of the measure causes a negative impact and this is due to the fact that to begin using LNG requires significantly large investments and reconstruction of ships and the infrastructure of ports.	-	No significant impact.	0
10.	Reduction of disposal of untreated wastewater into the sea, including ensuring reception of wastewater from cruise ships in ports.	The measure has a positive impact because the quality of seawater improves and generation of marine litter is reduced. People living on coast as well as tourists that are connected to the sea daily or for recreational purposes are influenced.	+	The impact is related to ports and wastewater treatment companies because upon implementation of the measure it is necessary to improve to certain extent the wastewater reception and treatment infrastructure, which means additional investments.	-	Implementation of the measure requires certain expenditures to be made (negative impacts) to offer the relevant service by adjusting port infrastructure.	-	No direct impact. An indirect positive impact is related to the improvement of seawater quality that contributes to the conservation of underwater cultural valuable objects and enables their studying.	0/ +
11.	Additional nutrient, hazardous	Upon implementation of the measure, it will have a positive impact on the	+	The measure is mainly designed for local authorities and water companies’	- /+	Implementation of the measure has a positive impact on water quality in port basins.	+	No direct impact. An indirect positive impact is related to the improved	0/ +

	SEA area	Impact on well-being and health of humans (including outdoor noise)		Impact on marine business environment (including fisheries, aquaculture, tourism etc.)		Impact on marine transport and ports (including traffic safety and security)		Impact on marine cultural heritage	
No.	Measure	Description of impact	S	Description of impact	S	Description of impact	S	Description of impact	S
	substance and litter inflow reductions from stormwater directly to the sea – the construction of stormwater sewerage and treatment systems.	wellbeing and health of humans mainly by the improved quality of bathing water and cleanliness of beaches.		operations. To implement the measure, investments are required that cause a short-term negative impact. A positive indirect impact on the tourism-related business because of the improved quality of bathing water and cleanliness of beaches.		The need to maintain the basin may decrease because of the reduced amounts of litter, sediments and oil product inputs into the sea through stormwater systems.		seawater quality that contributes to the conservation of underwater cultural valuable objects and enables their studying.	
12.	Establishing restrictions on ship traffic in case of wave exposure impact.	Implementation of the measure has a positive impact primarily on the holiday-makers that visit the beaches (improved safety because of reduced waves) as well as on people living on the coast (reduction of air pollution due to slower speeds, especially near ports).	+/ -	The measure is primarily related to passenger ships. The impact from the implementation of the measure is linked to the lengthening of time of voyage that has a negative impact on the companies that use passenger ship services; however, during a longer voyage, there is a potential to use more services offered on board of	- /?	Imposing speed limits in coastal sea has a positive impact because it increases navigation safety. However, ship owners (especially regular shipping lines) may have to compensate the lost time on the open sea and consequently sail at higher speeds that may reduce navigation safety.	+/ ?	Imposing speed limits in the coastal sea may potentially reduce the negative impact of waves on the preservation of underwater or partly underwater valuable cultural objects.	+

	SEA area	Impact on well-being and health of humans (including outdoor noise)		Impact on marine business environment (including fisheries, aquaculture, tourism etc.)		Impact on marine transport and ports (including traffic safety and security)		Impact on marine cultural heritage	
No.	Measure	Description of impact	S	Description of impact	S	Description of impact	S	Description of impact	S
		However, implementation of the measure may lengthen the time of voyage which means that the additional time may have a negative impact on the wellbeing of passengers.		the passenger ship. However, it may be expected that restricting speed will happen near the coastal zone that account for a small portion of the voyage (e.g. Tallinn-Helsinki).					
13.	Improving the efficiency of marine pollution prevention capacity to respond to environmental emergencies at sea.	Upon implementation of the measure, it will have a positive impact on the wellbeing and health of humans because marine pollution is detected and liquidated faster and the risk that it reaches the (including for example bathing beaches) coast is reduced.	+	No significant impact.	0	Implementation of the measure has a positive impact because the capacity of marine pollution control is improved. A long-term positive aspect is that requirements on the content of port pollution control and pollution control equipment are being prepared. However, adoption of new requirements causes expenses for port owners, or the measure is negative in short term.	+	Implementation of the measure causes some indirect positive impact on marine cultural heritage because faster detection and elimination of marine pollution reduces potential risks associated with pollution damage to the marine cultural heritage objects.	+

	SEA area	Impact on well-being and health of humans (including outdoor noise)		Impact on marine business environment (including fisheries, aquaculture, tourism etc.)		Impact on marine transport and ports (including traffic safety and security)		Impact on marine cultural heritage	
No.	Measure	Description of impact	S	Description of impact	S	Description of impact	S	Description of impact	S
14.	Control of environmental risks that accompany bunkering operations at sea.	Implementation of the measure has a positive impact on the wellbeing and health of humans, because more detailed requirements applying to bunkering reduces the risk of marine pollution reaching the coast (including for example bathing beaches).	+	Implementation of the measure means that the bunkering requirements will be more detailed and that may cause additional expenditures for the companies involved in shipping. However, it is currently not possible to give a more precise assessment of the impact.	-/?	Implementation of the measure means that the bunkering requirements will be more detailed and that may cause additional expenditures for the owners of ships and ports. However, they help to reduce costs related to the liquidation of marine pollution (e.g. liquidation of pollution in port basins).	?/+	Implementation of the measure has some indirect positive impact on the marine cultural heritage because faster detection and elimination of marine pollution and the potential damage of pollutants to the marine cultural heritage objects is reduced.	+
15.	Improving the marking system of fishing gear for better control and prevention of abandoning fishing gear.	No significant impact.	0	Implementation of the measure causes additional expenditures for fishermen (negative impact).	-	No significant impact.	0	No significant impact.	0
16.	Preparing an action plan to improve control over	An indirect positive impact due to the fact that elimination of abandoned fishing gear from the sea and	+	A certain positive impact is expected from the development of the established reception system	+	The measure is expected to have a certain positive impact on navigation safety and security because elimination	+	No significant impact.	0

	SEA area	Impact on well-being and health of humans (including outdoor noise)		Impact on marine business environment (including fisheries, aquaculture, tourism etc.)		Impact on marine transport and ports (including traffic safety and security)		Impact on marine cultural heritage	
No.	Measure	Description of impact	S	Description of impact	S	Description of impact	S	Description of impact	S
	fishing gear and clean the sea of abandoned fishing gear.	the coast (including bathing beaches) is improved (reduction of marine litter). This activity has a positive effect on the safety of bathers and drivers of recreational craft.		(reception points) and on the servicing companies.		from the sea of abandoned fishing gear is facilitated. This will reduce, for example, potential risks that may be caused by abandoned fishing gear (e.g. entanglement nets) getting around a ship`s motion screw.			
17.	Prevention of the marine littering problem and organisation of awareness building environmenta l educational events and cleaning sprees.	Implementation of the measure has a positive effect primarily on the wellbeing and health of people visiting the beach and coast. By raising awareness and organising actual cleaning sprees on the coast, it is possible to help people improve their behavioural patterns (reduction of beach littering).	+	No significant impact.	0	No significant impact.	0	An indirect positive impact is related to improving the cleanliness of beaches and the coast and their maintenance that helps appreciate marine related cultural heritage.	+
18.	Reducing the use of plastic bags,	Implementation of the measure contributes to the reduction of marine litter	+	No significant impact.	0	Implementation of the measure has a positive effect because it contributes to the	+	An indirect positive impact is related to the improvement of cleanliness	+

	SEA area	Impact on well-being and health of humans (including outdoor noise)		Impact on marine business environment (including fisheries, aquaculture, tourism etc.)		Impact on marine transport and ports (including traffic safety and security)		Impact on marine cultural heritage	
No.	Measure	Description of impact	S	Description of impact	S	Description of impact	S	Description of impact	S
	supporting relevant publicity and educational activities.	and achieving a much cleaner environment. A positive impact on the wellbeing and health of humans.				reduction of marine litter generation and the need of elimination thereof from port basins.		of beaches and the coast that helps appreciate marine cultural heritage.	
19.	Preparing and implementing action plans of local authorities in coastal regions to prevent and reduce marine litter.	Implementation of the measure contributes to the reduction of marine litter and cleanliness of beaches and achieving a much cleaner environment. A positive impact on the wellbeing and health of humans.	+	In long term, the measure helps reduce the amount of marine litter and thereby reduces by-catch of litter.	+	Implementation of the measure has a positive impact because it contributes to the reduction of generating marine litter and the need to eliminate it from port basins.	+	An indirect positive impact is related to the improvement of cleanliness of beaches and the coast that helps appreciate marine cultural heritage.	+
20.	Organisation at ports a common marine litter reception system.	Implementation of the measure contributes to the reduction of marine litter and achieving a much cleaner environment. A positive impact on the wellbeing and health of humans.	+	Implementation of the measure causes a certain negative impact on the companies that offer port services because launching of the system requires additional expenditures to be made.	-/+	Implementation of the measure has a positive impact because it contributes to the reduction of generating marine litter and the need to eliminate it from port basins. However, this measure requires certain technical	+	An indirect positive impact is related to the improvement of cleanliness of beaches and the coast that helps appreciate marine cultural heritage.	+

	SEA area	Impact on well-being and health of humans (including outdoor noise)		Impact on marine business environment (including fisheries, aquaculture, tourism etc.)		Impact on marine transport and ports (including traffic safety and security)		Impact on marine cultural heritage	
No.	Measure	Description of impact	S	Description of impact	S	Description of impact	S	Description of impact	S
				In long term, the measure helps reduce marine litter and thereby by-catch of litter. This measure also creates an opportunity to give over litter caught from sea in ports instead of throwing it back into the sea.		rearrangements to be made in ports.			
21.	Establishment of impulse sounds register	The measure is intended for identification of underwater noise and therefore it has no direct link to outdoor noise that influences the wellbeing and health of humans. However, in many cases, the sources that cause underwater noise cause also noise that travels in the air (pile-driving noise when waterwalls are constructed etc.) that has an impact on the people that live on the coast. Consequently, it is necessary to consider in	0/ +	No significant impact.	0	Establishment of the register helps increase the awareness about activities at sea that cause noise. It is possible to use this information, for example, when planning port developments.	+	No significant impact.	0

	SEA area	Impact on well-being and health of humans (including outdoor noise)		Impact on marine business environment (including fisheries, aquaculture, tourism etc.)		Impact on marine transport and ports (including traffic safety and security)		Impact on marine cultural heritage	
No.	Measure	Description of impact	S	Description of impact	S	Description of impact	S	Description of impact	S
		addition to mapping underwater noise also to map outdoor noise caused by the same source. This helps to acquire comprehensive information about noise sources that are related to the marine environment.							

5.2 Area-specific summaries of the impact analysis and proposals

5.2.1 Impact on marine biota and habitats (including impact on protected natural objects)

The new measures of the Estonian Marine Strategy`s programme of measures have been developed to achieve good status of the marine environment and are designed to prevent and reduce human-induced pressures. The main factors that may damage the natural marine habitats and biota and cause changes in the marine ecosystem, is inputs of nutrients, marine litter, noise (including underwater), invasion of non-indigenous species and selective catching of species. The habitats are at the risk of physical damage, siltation, smothering and sealing.

The new developed measures are divided by the descriptors of good environmental status (GES), although one measure may have an impact on several descriptors. Almost all new measures have a direct or indirect positive impact on the marine habitats, marine biota and protected natural objects, but there are also measures which impact is relatively difficult to assess due to lack of information. Measures which extent of positive impact is currently difficult to assess are "Establishing a marine protective areas network in Estonia´s economic zone" (1), "Promotion of realisation of low-value fish" (7), "Imposing restrictions on ship traffic in case of wave exposure impact" (12) and "Establishing an impulsive sound register" (21).

5.2.2 Impact on the quality and physical indicators of seawater

The Baltic Sea, including the Estonian marine area, is under strong human influence. Regardless of many environmental protection measures, according to several indicators, good environmental status in the Estonian marine area has not been achieved yet.

The new measures can be classified by the impact on seawater quality and the physical indicators of the marine environment: direct positive impact and indirect impact. The uncertainty of an impact of measures is different and depends on the preciseness of specification of measures but also on how good is current knowledge about the particular components of the natural environment.

Direct positive impacts (measures 1–3, 9–13, 17–21)
Two first measures ("Establishing a marine protection areas network in Estonia`s economic zone" and "Adoption and implementation of the ringed seal protection plan") mean establishment of protected areas and they have a direct positive (preventive) impact. The most important positive impact is prevention of pressures related to the development of certain marine areas (future protected areas). However, the neighbouring areas of the future protected areas may experience a stronger impact of anthropogenic pressures. This is the sole theoretical negative cross-border impact on seawater quality and its physical indicators. The overall impact of protected areas on the marine environment is positive. To create the maximum positive impact and reduce negative impacts, it is necessary to make a detailed (risk) analysis when selecting the locations for these protected areas, taking into account also neighbouring areas.

The third measure ("Developing regional aquaculture plans to control a possible environmental pressure") has a direct positive preventive impact. The measure alleviates, in a preventive manner, environmental impacts related to aquaculture, primarily impacts caused by inputs of substances (including nutrients) into the sea. It must be noted that due to eutrophication of the

Baltic Sea, preference should be given to development of nutrient-neutral aquaculture practices or aquaculture that uses nutrients of the marine environment (nutrient-negative), in which case taking nutrients out of the marine environment may have a positive impact. Currently it is difficult to assess the extent of effect of the third measure on the pressures based on the existing information. The extent of the impact will become clear during implementation.

Measures 9−11 (“Promotion of use of liquefied natural gas (LNG) as ship fuel”, “Reduction of disposal of untreated wastewater into the sea, including ensuring reception of wastewater from cruise ships in ports”, “Additional nutrient, hazardous substance and litter inflow reductions from stormwater directly to the sea – the construction of stormwater sewerage and treatment systems”) have a direct positive effect on eutrophication and concentrations of hazardous substances. The impact of these pressures is measurable. Whether the reduction in the impact of these pressures will lead to a better marine environment status should be seen by monitoring and relevant environmental indicators.

It is likely that upon implementation of measure 12 (“Imposing restrictions on ship traffic in case of wave exposure impact”) will have a direct positive impact. The objective of the measure is to control exposure to waves caused by ships. In terms of natural environment, the measure should control the impact of ship-generated waves on the coastal processes, but also somewhat to the thermohaline structure. The draft programme of measures does not include references to the existing marine environment problems in relation to ship-generated waves. Consequently, it can be presumed that the author has considered potential impacts in the future. The measure specifies imposition of restrictions on the presumed impact (erosion) on the coast and structures thereon. To determine the presumed impact, it would be necessary to monitor the marine area exposed to ship waves and make correlation between waves and changes on the coasts and then separate the impact of high-speed craft waves from natural waves. An expert group reviewed the monitoring report of past three years (OÜ Geoloogiakeskus 2013–2015) and they did no find there any relevant analysis or any reference to an environmental problem concerning ship-generated waves. The impacts caused by high-speed craft waves have been studied in the past decade in Tallinn Bay and it was found that there exists an impact on sediment transport (Soomere *et al*. 2009). Nowadays ships are slightly slower but larger, which is why ship waves is still a relevant issue. Imposing ship speed limits in Väinameri region, which is a shallow marine area with many valuable habitats, have been discussed. Speed limits have already been imposed in some restriction zones of some protection areas (Keskkonnaamet, 2012. Väinameri conservation area sea part, permanent habitats of Kadakalaiu ringed seals, Pujuderahu grey seals and Selgrahu grey seals (part of Väinameri bird and nature area) protection plan 2013–2022). In summary, currently there is no information that ship waves pose a problem for the natural environment (coastal processes) in the Estonian marine area as a whole. There is a certain impact in Tallinn Bay where other human activities (artificial coasts – ports, Pirita tee etc.) have already significantly influenced natural coastal processes and will influence them in future. Consequently, the expert group does not see the need of this measure solely from the natural environment point of view. This is a local impact in the region where other anthropogenic impacts on the coastal processes, but also natural processes (wind waves) play a much more significant role. A more important aspect is the impact of high-speed craft waves on the navigation safety of recreational craft, especially in the coastal zone and quiet weather, when high-speed craft waves unexpectedly reach the coastal zone and threaten recreational craft. In summary, this measure that is necessary for navigation safety has a positive side effect also on the physical natural environment but the measure must be worded in accordance with its main objective - navigation safety. If the paraphrased measure does not fit into the Marine

Strategy`s programme of measures, then the implementation of this activity should be considered with the help of other mechanisms in Estonia, for example by implementing the Development Plan of the Marine Policy.

Measures 13 and 14 (“Improving the efficiency of marine pollution prevention capacity to respond to environmental emergencies at sea”, “Control of environmental risks that accompany bunkering operations at sea”) have a direct positive impact on the reduction of content of hazardous substances in the sea by increasing the pollution control capacity and reducing pollution risks.

Measures 15−20 (“Preparing an action plan to improve the control over fishing gear and clean the sea of abandoned fishing gear”, “Improving the marking system of fishing gear for better control and prevention of abandoning fishing gear”, “Prevention of the marine littering problem and organisation of awareness building environmental educational events and cleaning sprees”, “Reducing the use of plastic bags, supporting relevant publicity and educational activities”) have a direct positive impact on the reduction of marine litter.

Measure 21 has a direct positive impact on underwater sound field pollution. Currently, there is no information about the spatial and temporal distribution of anthropogenic noise and its impact in the Estonian marine areas. During the implementation of the measure, a database will be created that presumably allows to determine the significance of noise as a pressure on the environment. Such database allows to assess noise level trends and associate critical excessive noises with the source. Additional measures can be implemented if a significant environment impact occurs.

Measures (4*−*8) with indirect impact
Measure 4 (“Awareness building about non-indigenous species to control their invasion”) and measure 5 (“Ratification of the international Ballast Water Management Convention (BWMC), facilitation of implementation by participation in the regional information system and its implementation”), which objective is to address the problem of non-indigenous species in the Estonian coastal sea, have an indirect impact. Improving the awareness about non-indigenous species hopefully improves the general attitude of population towards the marine environment. Application of the Ballast Water Management Convention does not probably play an important role in influencing the physical indicators and quality of seawater besides its local impact. At least it is not known that releasing ballast water into the sea would have a significant negative environmental impact on the quality and physical indicators of seawater in the Estonian marine areas.

Measures 6−8 influence positively fish populations. The impact is carried through the food chain into the circulation of substances but it is presumably insignificant against other variability.

It is presumed that the impacts of measures 4−8 on the quality and physical indicators of seawater are so modest that it is not possible to identify their impact on the natural environment.

5.2.3 Impact of measures in the contexts of GES effort

In the work prepared by of Estonian Marine Institute of Tartu University (TÜ Eesti Mereinstituut) (2012b) there are presented indicators by the descriptors of good environmental status (GES). These indicators should demonstrate whether GES has been achieved or not. The indicators are allocated between 11 GES descriptors. Based on the referenced report, there were three types of problems: (1) GES has not been achieved, (2) an indicator needs improving, and (3) no indicator in Estonia. We will now discuss using GES descriptors whether and how the new measures contribute to achieving GES.

For the first descriptor (Biological diversity is maintained), GES has been achieved according to several indicators. GES was not achieved by three indicators: range of the ringed seal, range type of the ringed seal, abundance index of predator fish in monitoring catches. Measure 2 has been specifically created for the two unachieved indicators concerning the ringed seal. All other measures have a positive effect on seals as the apex predator in the sea, especially the measures that target marine litter and help prevent/reduce contamination with hazardous substances. Measures 6–8 help increase the abundance of predator fish but important are also measures that target marine litter (especially those that are dealing with abandoned gear) and measures that are designed to control hazardous substances. Predator fish are seals` competitors, but also food for seals. Consequently, by facilitating one aspect, the other is also influenced and vice versa. As the measures are designed to generally reduce human influence and have a positive environmental impact, it is not foreseen that by facilitating one group there will be a significant negative environmental impact on the other.

For the second descriptor (Non-indigenous species introduced by human activities are at levels that do not adversely alter the ecosystems), not achieved GES indicators prevailed: abundance of pelagic non-indigenous invertebrates, biomass of non-indigenous benthic large invertebrates, percentage of non-indigenous species in zooplankton community biomass, level of biological contamination. To curb further spread of non-indigenous species and control the level of biological contamination, measures 4 and 5 are proposed. It can be expected that the measures may lead to achieving GES in terms of the level of biological contamination and percentage of non-indigenous species in the zooplankton community biomass. The measures will have a positive impact regarding the other two indicators but the effect is preventive in nature, i.e. an effort is made to avoid invasion of new non-indigenous species. However, it is not clear how it is possible to achieve GES with these indicators, i.e. reduce the percentage/abundance/biomass of non-indigenous species that have already adjusted here. GES definition according to these two indicators is "at least in 80% of the indicator`s time series the abundance of non-indigenous species level during the assessment period is not higher than the lowest abundance registered in the relevant time series". <u>It may be necessary to review these two indicators and word them in accordance with the target related to non-indigenous species, which is that new non-indigenous species are not added by primary invasion.</u>

For the third descriptor (Populations of all commercially exploited fish and shellfish are within safe biological limits, exhibiting a population age and size distribution that is indicative of a healthy stock), indicators that have not been achieved prevailed: fishing mortality rate of the Baltic herring (*Clupea harengus membras*), fishing mortality rate of the sprat (*Sprattus sprattus balticus*); yield index of non-indigenous species in monitoring net catches, abundance of salmon smolts (*Salmo salar*) compared to the maximum natural potential abundance, abundance index of adult perch (*Perca fluviatilis*) in monitoring catches, abundance index of large perch (*Perca fluviatilis*, TL > 250 mm) in monitoring catches, the perch (*Perca fluviatilis*) length 95% percentile in monitoring catches. Clearly steps have been taken to create a positive impact. Measures 6–8 that deal with fisheries and measures that address the abandoned gear problem (measures 15–16) have a very significant impact. Almost all other measures have positive impacts. Some indicators may be negatively influenced when better conditions are created for seals and predator fish, but as the measures are designed to reduce human influence in general, it is presumed that the negative impact is insignificant.

For the fourth descriptor (All elements of the marine food webs, to the extent that they are known, occur at normal abundance and diversity and levels capable of ensuring the long-term abundance of the species and the retention of their full reproductive capacity), mostly indicators that have not yet been achieved prevailed: abundance of salmon smolts (*Salmo salar*) compared to the maximum natural potential abundance, abundance index in monitoring catches of large perch (Perca fluviatilis; TL > 250 mm), ratio of maxillopodans biomass to the entire mesozooplankton biomass, abundance index of predator fish in monitoring catches. In the draft programme of measures each measure has targets that the particular measure contributes to. The three targets of the fourth descriptor have not been mentioned in relation to any measure. However, it is likely that measures that address eutrophication (9−11) and fisheries (6−8) and abandoned fishing gear (measures 15 and 16) will have a positive impact.

For the fifth descriptor (Human-induced eutrophication is minimised, especially adverse effects thereof, such as losses in biodiversity, ecosystem degradation, harmful algae blooms and oxygen deficiency in bottom waters), GES was not achieved by the following indicators: total nitrogen concentration in seawater in summer, total phosphorous concentration in seawater in summer, concentration of chlorophyll a in seawater in summer, phytoplankton biomass in summer, transparency of seawater in summer according to the Secchi disc. As eutrophication influences an ecosystem through primary production, its impact has an effect throughout the entire food chain, both in the water column as well as on the seafloor. Measures 9−11 have been designed to reduce eutrophication and measure 3 is expected to have a positive preventive impact. The presented measures are necessary, for sure, and they facilitate addressing the eutrophication problem. The unresolved issue is the question how to adequately measure/monitor the efficiency of measures. The problem is that the parameters that serve as indicators, such as nutrients concentrations and indicators describing water transparency, change in time and space very quickly. Secondly, there is no functioning indicator that would describe the time cycle of dissolved oxygen in our marine areas. Oxygen deficiency is one of the gravest problems in the Baltic Sea and the Estonian marine areas and partly a result of eutrophication. The parameters describing eutrophication depend largely on the physical and hydrodynamic conditions of the water column. During marine monitoring, data are gathered on physical and chemical parameters, but monitoring frequency is too infrequent (6−12 times a year). Hydrodynamic parameters (waves, currents) are not measured with modern equipment within the framework of national monitoring (the Weather Service assesses waves visually). Monitoring of parameters that describe/influence base production must be significantly improved. The world practice shows that in the field of monitoring of parameters that influence primary production the focus is shifting to autonomic equipment, such as buoy stations, gliders etc. In Estonia, only autonomic measuring from ferries (Ferrybox, Tallinn-Helsinki and Tallinn-Stockholm) has been included in the Estonian national monitoring programme, but data is gathered only from the surface layer. The national monitoring effort must be updated and in addition to traditional monitoring trips, autonomic continuous measuring of currents, wave regime, temperature, salinity, chlorophyll *a* fluorescence, dissolved oxygen and nutrients should be included in the monitoring programme. This proposal (to add autonomic measurements at buoy stations to the programme) have also been made in the draft marine monitoring programme (TTÜ Meresüsteemide Instituut 2014).

GES was achieved for the sixth descriptor (Sea floor integrity is at a level that ensures that the structure and functions of the ecosystems are safeguarded and benthic ecosystems, in particular, are not adversely affected) according to four indicators; however, four indicators require improvement. Establishment of protected areas (measure 1 and 2) have a positive impact that will ensure maintenance of certain type open sea floors. Measures 9−11 that target reduction of eutrophication, measures that address the problem of non-indigenous species (measures 4 and 5), control ship-generated waves (measure 12), manage shipping accident risks and reduce their impact (measures 13 and 14), deal with marine litter (measures 15−20) have a significant positive influence. Fisheries related measures (6−8) have a positive impact if the trawling intensity reduces. Measure 3 has a positive preventive effect. The current functioning indicators show that GES has been achieved. <u>The problem is that there is no database on physical pressures, such and dredging, excavation and dumping. In order to assess the impact of these activities on the integrity of the seafloor of the Estonian marine area, a relevant database should be created.</u>

No useable indicators were available for the seventh descriptor (Permanent alteration of hydrographical conditions does not adversely affect marine ecosystems). The measure that helps control ship-generated waves is designed to address the issue of alteration of hydrographical conditions. What is paradoxical is that the new measure is designed to reduce the impact of ship-generated waves on hydrographical conditions, but still the issue of applicable indicators remains unresolved − there are none. Presumably the human-induced impact on hydrographical conditions in the Estonian marine area is not very strong: the larger water buildings have the strongest impact (e.g. Väike väin dyke), also changing the coastline and dredging and high-speed craft generated waves to certain extent. Regardless, it is important to monitor hydrographic changes adequately, as we described in the subsection of the fifth descriptor, to understand the dynamics of eutrophication and oxygen. The proposal is to update monitoring of physical indicators and develop usable indicators. The new measures are not designed to resolve/analyse the impacts of water exchange related to the largest water building (Väike väin dyke) in the Estonian marine areas. The local authorities are interested in making openings into the dyke. As it is presumed that making openings into the Väike väin dyke has no long-term negative environmental impacts, but positive impacts, then **we suggest to include in the additional studies of the programme of measures a study with the objective of analysing additionally the environmental protection feasibility and economic profitability of making openings into the Väike väin dyke.**

Most of the indicators (28) of the eight descriptor (Concentrations of contaminants are at levels not giving rise to pollution effects) showed that GES has been achieved. There was not one indicator according to which GES was not achieved. Seven indicators were not applicable. Although indicators show that GES has been achieved, there are two measures (12 and 14) that are designed for the eight descriptor and address pollution control and reduction of environmental risks accompanying bunkering. This is justified because the risk of a ship accident is the highest environmental risk in the Estonian coastal sea due to the growing traffic intensity. In addition to the measures that are directly designed for the descriptor, the measures that address eutrophication (measures 10 and 11), but also measures that deal with marine litter (15−20) have a significant positive impact on the spread of contaminants. It is suggested to add into the list of the indicators of the eight descriptor parameters that would directly describe oil pollution found on the sea. For example, PF (Pollution per Flight) index can be used that shows the number of found spills per flight hour (see Figure 2.14). There are nuclear power plants on the coasts of neighbouring countries, but currently Estonia has no capacity to detect an increase of radioactivity in the sea. Hence, we suggest to establish an operative radioactive detection system in the Estonian marine areas. As a first step, a constant monitoring of radioactivity in the Gulf of Finland should be introduced. The detector(s) may be integrated into, for example, the first autonomic offshore Baltic Sea measuring station near the Keri Island.

For the ninth descriptor (Contaminants in fish and other seafood for human consumption do not exceed levels established by Community legislation or other relevant standards), GES was achieved by seven indicators, in one case the indicator was not applicable. New measures have not been suggested for the ninth descriptor, but measures (13 and 14) dealing with pollution control and reduction of environmental risks associated with bunkering operations, measures designed to control eutrophication (10 and 11) and marine litter related measures (15–20) have a positive impact. Aquaculture related measure 3 is preventive and measure 5 that addresses ballast water treatment may have certain influence.

There were no applicable indicators related to the tenth descriptor (Properties and quantities of marine litter do not cause harm to the coastal and marine environment). Measures 15–20 that are designed to reduce marine litter all contribute to solving the problem. As currently there are no useable indicators that would characterise the changing spatial and temporal condition of marine litter, the suggestion is to find them. The expert group is of an opinion that (at least some) indicators offered in the programme of measures can be used. Monitoring should be also organised in accordance with the indicators and it should begin before implementation of the measures.

There were no useable indicators for the eleventh descriptor (Introduction of energy, including underwater noise, is at levels that do not adversely affect the marine environment). There is no long-term and sustainable noise monitoring activities organised in the Estonian marine areas. Measure 21 is a step forward in this respect.

Table 5.2. Expected impact of new measures on achieving GES.

Legend

(grey)	*No indicators*	-	*No indicators*
(orange)	*GES partly achieved*	*No direct measures, side effect of other measures*	*The measure have a positive effect, but it can be improved*
(red)	*GES not achieved*	-	-
(green)	*GES achieved*	*Measures are relevant for achieving/maintaining GES*	*The measure has a positive effect*

Descriptor	Status according to 2012 indicators	New measures	Expected outcome
1	Generally GES achieved, not achieved according to some indicators	A special measure to improve GES indicators	A change towards achieving GES
2	GES mainly not achieved	Two special measures to move towards GES	A change towards achieving GES
3	GES mainly not achieved	Three special measures to move towards GES	A change towards achieving GES

4	GES mainly not achieved	No special measures, but certain positive impact from other measures	A change towards GES possible
5	GES not achieved for a significant number of indicators	Three special measurer to move towards GES	A likely change towards achieving GES, **but the national monitoring programme needs to be improved to determine it**
6	GES mainly achieved, some indicators unusable	No special measures, but the combined impact of all other measures is significant	A change towards achieving GES
7	No usable indicators	Some measures have positive side effects but do not resolve the indicators problem	Still not one useable indicator. **Monitoring requires improvement and indicators need to be developed**
8	GES mainly achieved, no oil pollution indicators	Two special measures to move towards GES	A change towards achieving GES
9	GES mainly achieved	Several measures help maintain GES	GES maintained
10	Not one useable indicator	Six special measures that include also indicators	The problem is known and usable indicators have been developed
11	Not one useable indicators	A special measure that also includes indicators	The problem is known and usable indicators have been developed

Summary

The new measures have a positive impact on all GES descriptors (see Table 5.2). There is a disproportionately high number (six) of marine litter related measures that could be combined. It should be possible to conduct together activities that are designed to improve people`s awareness (measures 4 and 17). The existing monitoring must be improved to measure the positive effect of the fifth descriptor. The same applies to the seventh descriptor.

A certain negative impact may occur on the neighbouring areas of the new protected areas, which is the only theoretical cross-border impact of natural environment. The overall impact on the Baltic Sea environment of protected areas is positive. The measures have a positive impact with a varying degree on the components of the ecosystem that influence the interactions of these components. As the measures in combination reduce human influence in the marine environment, there is no reason to think that influencing the components with varying degree would cause a significantly negative environmental effect.

Our proposals

- **We recommend to establish an operative radioactive detection system in the Estonian marine areas.** As the first step, constant monitoring of radioactivity in the Gulf of Finland could be introduced. The detector(s) may be integrated into the first autonomic offshore measuring station of the Baltic Sea near the Keri Island.
- **We recommend to establish a common database on excavation and dredging and dumping operations on the sea**.

- The database would give a comprehensive overview of the works being done that modify the coast and seafloor in the Estonian marine areas. The database could be used in spatial planning, in the environmental impact assessment process of property development and during monitoring. The database should include information about the presumed dredging (dumping) volume (in the phase of applying for a permit of special use of water), the actual dredging volume (will be clear after the works have been performed), integration of sediments and content of hazardous substances in sediments. If the works have been monitored, the database should include references to the monitoring reports. **Based on the gathered data, it is possible to prepare a pressure indicator of excavation and dredging and dumping operations** in the Estonian marine areas.
- **Measure 12 has a positive impact on navigational safety and a certain positive side effect on the natural environment, but the measure should be worded in accordance with its main objective, which is navigational safety.** If the reworded measure does not fit into the Marine Strategy`s programme of measure any more, implementation of the activity in Estonia should be considered through other mechanisms, for example, implementation of the Development Plan of the Marine Policy.
- **We recommend** to continue with the tradition that has developed during the environmental impact assessment process: **not to conduct dumping operations in shallows areas in coastal regions.** For that purpose, the distribution of official dumping sites in the Estonian coastal sea must be reviewed and, if necessary, changed. An exception is the areas with active sediment transport where it may be reasonable to release dredged material on the coast or into a trench near coast to reduce this deficiency (this suggestion can be made by the expert group of environmental impact assessment). **Estonia has to conduct an inventory of dumping sites based on the London convention.**
- **We recommend to include a study for an additional analysis of the environmental protection feasibility and economic profitability of making openings into Väike väin dyke to the additional studies of the programme of measures.**

The problems of marine environment monitoring and GES indicators are not directly the topic of the programme of measures. However, it is important to resolve the issue of indicators before the implementation of the measures begins. Otherwise, it is not possible to determine the efficiency of the measures or make decisions on the following steps. Based on that, the expert group has the following observations and suggestions on GES indicators and the monitoring programme:

- **To review two indicators related to non-indigenous species and word them in accordance with the target set on the non-indigenous species, which is that new non-indigenous species are not added through primary invasion;**
- **To add constant automatic measurements of currents, waves, temperature, salinity, chlorophyll *a* fluorescence, dissolved oxygen and nutrients to the national marine monitoring programme.** Measuring of some of the listed parameters have been suggested prior (TTÜ Meresüsteemide Instituut, 2014);
- **To develop usable indicators for the descriptor "Permanent alteration of hydrographical conditions does not adversely affect marine ecosystems";**
- **To add a parameter to the list of indicators for the descriptor "Concentrations of contaminants are at levels not giving rise to pollution effects" that would directly describe the frequency and volume of oil pollution detected on the sea. For**

example, PF (Pollution per Flight) index can be used that shows the number of spills detected per flight hour;

- **To develop usable indicators for the descriptor "Properties and quantities of marine litter do not cause harm to the coastal and marine environment", we suggest to consider using (at least partly) the indicators offered in the programme of measures as GES indicators. The selected indicators should be added to the national marine monitoring programme.**

5.2.4 Impact on air quality (including outdoor noise) and climate changes

As described in section 2.3.6, air pollution caused by marine transport has a significant and wider impact on air quality and climate. Noise has also negative impacts. The Baltic Sea is a SECA, where compared to regions of no such status, stricter norms have been imposed on the sulphur content of ship fuel. In addition, NO_x that contains in ship exhausts contributes to sea eutrophication. Various activities related to operations on the sea (e.g. pile-driving, explosions etc.) cause underwater noise as well as propagation of noise outdoors. Based on the above, it is important to continue reducing air pollution and noise caused by marine activities.

The area-specific analysis of measures specified in the Marine Strategy`s programme of measures (see Table 5.1, chapter 5.1) showed that most measures have a direct or indirect positive impact on the improvement of air quality. The measure that has the largest positive impact is related to the use of cleaner ship fuel, i.e. facilitating introduction of LNG.

In terms of air quality, it is evermore important to introduce cleaner ship fuels, e.g. LNG. Based on the study of Tallinn University of Technology Estonian Marine Academy (TTÜ Eesti Mereakadeemia) (2015), LNG as ship fuel differs radically from the liquid or bioliquid fuels produced from traditional oil (or e.g. oil shale) in terms of storage, processing and using in motors. Therefore, it is not possible to use LNG on the existing ships that operate on liquid fuels without labour-intensive and expensive reconstruction. Furthermore, port infrastructures that have been developed over decades do not meet the requirements for storing, processing and bunkering LNG. Consequently, transition in the shipping sector from liquid fuels to natural gas is inevitably a long-term process and for at least 20–30 years traditional liquid fuels will remain dominant – regardless of all the benefits that using LNG offers. Upon introduction of LNG on ships, the volume of exhaust gases released into air compared to traditional liquid fuels significantly decreases (SO_x - 99%; NO_x - 90%; CO_2 - 25%; PM - 99%) and fuel savings increase. In summary, the study by Tallinn University of Technology Estonian Marine Academy (2015) has come to the following conclusion: "There is a sufficient potential to use LNG and a necessary pressure on the market that introduction of LNG could continuingly develop on sea and on land. From the point of the marine environment, using LNG as ship fuel is much more environmentally sustainable as the current main liquid fuels used on the Baltic Sea, and in the opinion of the authors, introduction of LNG as ship fuel is an important measure in reducing atmospheric pollution caused by shipping. However, from the climate warming aspect, attention has been drawn to the fact that LNG is natural gas that contains methane (Oregon Sierra Club, 2014). Methane is a very significant greenhouse gas. Methane leakage is possible in different stages of LNG production, transport and other activities that have a negative impact on the climate warming. Besides, production of LNG is an energy-intensive process. Consequently, in fighting climate warming, using LNG may be inefficient, but given that the LNG topic is quite new, it is not yet possible to make conclusions.

The measure (Establishing impulsive sounds register) of the programme of measures is designed to identify underwater noise and therefore does not directly deal with propagation of outdoor noise. However, in many cases, an activity that causes underwater noise causes also outdoor noise (e.g. pile-driving during the construction of quays etc.) that has an effect on the marine and coastal biota (e.g. birds) as well as people that live on the coast. Therefore, it is reasonable to consider during establishing the register of underwater noise to enter into the register data about outdoor noise caused by the same sources. This would help to gather comprehensive (underwater and outdoor noise) information on the noise sources related to the marine environment.

Taking into account the above, the author of SEA makes a suggestion to gather during the establishment of the impulsive sound register (a measure of the programme of measures) data on outdoor noise caused by the same source into the register.

5.2.5 Impact on sustainable use of natural resources and resources

According to section 2.3.3 Natural resources (earth minerals, wind) and exploitation thereof, sand and mud resources, exploiting of wind and wave energy potential and algae can be considered natural resources in the Estonian marine areas.

Currently, there are no windfarms in the Estonian marine areas, but the county planning documents of the marine area bordering Hiiu and Pärnu County are being prepared and this planning foresees suitable areas for offshore windfarms. According to the National Spatial Planning "*Estonia 2030+*", primarily the western coastal sea is suitable for the establishment of offshore wind parks.

Wind energy has a big potential in Estonian energy sector, providing an additional energy source and an opportunity to reduce greenhouse gases. Consequently, it is important that the measures established in the programme of measures would not hinder establishment of offshore wind parks. At the same time, offshore wind parks should not jeopardise achieving of good environmental status of the marine area.

According to the analyses made in section 5.1 (Table 5.1), implementation of the measures established in the programme of measures will have mainly a positive impact on the sustainable use of natural resources and resources. Upon implementation of the measures, the status of the marine environment will improve and the risk of pollution that could damage commercial fish and algae stocks will decrease. The measures will also help create conditions for a sustainable growth of the aquaculture sector.

A certain negative impact may be caused by the establishment and implementation of the protection plan for the ringed seal that places restrictions on extraction of earth resources, establishment of wind generators or development of aquaculture.

Fuel costs would reduce if liquefied natural gas (LNG) will used as ship fuel that has a greater energy value than diesel fuel. This promotes a positive resource use. Smaller fuel consumption also means smaller volumes of exhausts released into the air. A negative impact is the need to reconstruct the existing ships or build new ships that can use LNG as ship fuel which also means using natural resources.

Awareness-building campaigns and educational activities undertaken with the aim of reducing the use of plastic bags, and ultimately their production, helps support reduction of use of non-renewable resources. By making the marine litter reception system more efficient, an option is created in ports to dispose of marine litter and recycle it, contributing so to saving natural resources.

Establishing an impulsive sound register helps increase awareness of underwater noise that may cause imposition of restrictions on excavation and establishment of wind turbines in the region where there are deposits or where offshore wind parks are planned to be built. However, establishing the register may dissolve doubts about the impact of underwater noise on the biota.

In summary, the topics referred to in the beginning of the section have been covered by the measures of the programme of measures or the objectives and measures of the Estonian Marine Policy 2012–2020 and the author of this report does not see any need to highlight any new potential topics that have not been discussed in the programme of measures.

5.2.6 Impact on the well-being and health of humans (including outdoor noise)

The well-being and health of humans are influenced by many circumstances from air pollution and noise to the general cleanliness of the marine environment and recreational opportunities.

The sector-specific analysis of the measures included in the Marine Strategy`s programme of measures (see Table 5.1, section 5.1) showed that most measures have a positive impact on the well-being and health of people. The impact is mainly related to the fact that as the result of implementation of the measures seawater quality and air quality will improve and generation of marine litter will be reduced. This will have an effect on the lives of people that live on the coast as well as tourists (as regards air quality, also crewmembers). The measures that may cause imposition of restriction on the movement of waterborne vessels or limit speed (e.g. possible restrictions on movement near the resting grounds of the ringed seal) have a certain negative impact primarily on the well-being of marine tourists. However, it can be presumed that the restrictions are local and do not cause a significant negative impact.

The measure of the programme of measures that specifies establishing of the impulsive sound register is designed to identify underwater noise and does not directly deal with outdoor noise. However, in many cases, the source of underwater noise is the same as the source of outdoor noise (e.g. pile-driving during the construction of waterwalls etc.) that influence people living on the coast. Consequently, it is reasonable to consider entering into the register also data on the same sources of outdoor noise. This enables gathering comprehensive (both underwater and outdoor noise) information about the noise sources related to the marine environment.

Taking into account the above, the author of the SEA suggests that when the impulsive sound register is established then data on the same sources that cause also noise above water are gathered into the register.

5.2.7 Impact on the marine business environment (including fisheries, aquaculture, tourism etc.)

In accordance with section 2.3.1, in maritime business it is important to ensure Estonian shipping companies equal competitive conditions, at least with the neighbouring countries. Another objective is to develop international marine tourism in the coastal regions further away from Tallinn. As regards fisheries activities, it is important to find a balance between fishing opportunities and the existing resource. In addition to the above, offshore aquaculture should be tested in Estonian conditions, because there are sites in the Estonian marine area that potentially are suitable for offshore aquaculture.

Of the above topics, fisheries and offshore aquaculture are the topics that are directly included in the programme of measures. A positive impact on the development of aquaculture is expected to occur due to the measure “Developing regional aquaculture plans to control a possible environmental pressure” included in the programme of measures. The measures of the programme of measures addressing fisheries (measures 6–8, Table 5.1, section 5.1) are designed to improve reproduction capacity of fish populations and are primarily related to imposing restrictions on fishing. The mentioned measures have a short-term negative impact on the companies involved in the fisheries sector (including coastal fishermen). However, it is a short-term impact and what is important is that fishing is not entirely banned. If the measures are not implemented, important commercial fish stocks will continue to decline that will have also a negative impact on the fisheries sector in long term. If the measures are implemented, a positive impact may be expected in long term, because it is presumed that the state of fish stocks will improve, allowing continuing with fishing as a traditional business. The short-term negative impact may be alleviated to a certain extent by the measure “Promotion of realisation of low-value fish”.

Shipping and marine tourism problems are mainly addressed within the framework of the Development Plan “Estonian Marine Policy 2012–2020” and consequently there is no need for additional measures to be included in the programme of measures. Based on Table 5.1, implementation of the measures of the programme of measures has a positive impact on business in long term (because of the improved marine environment status) or a significant impact is not foreseen. To implement certain measures (measures 5, 9, 10, 14, 15, 20), companies involved in maritime industry have to make some additional investments (a negative impact). Therefore, it is important to develop a national support system and implement it.

In summary, the topics referred to in the beginning of the section have been covered by the measures of the programme of measures or the objectives and measures of the Estonian Marine Policy 2012–2020 and the author of this report does not see any need to highlight any new potential topics that have not been discussed in the programme of measures.

5.2.8 Impact on marine transport and ports (including navigational safety and security and marine rescue)

According to section 2.3.2, the Baltic Sea is an easily threatened marine area and a pollution-sensitive ecosystem, and also a region with intensive vessel traffic. Hence, efforts must be continued in future to improve navigational safety and security in the region. It is also important to continued improving marine rescue capacity (including, for example, renewing of appropriate equipment). In addition, from the socio-economic aspect, it is important to deal with ports (including small and fish harbours) and the development of relevant infrastructure therein.

According to the analysis made in section 5.1 (Table 5.1), a long-term positive impact from the implementation of the measures of the programme of measures is achieved that mainly is expressed in a cleaner marine environment (e.g. reduction of litter in port basins), better pollution control capacity (e.g. reduction of possibilities of pollution reaching port basins) and enabling development of port infrastructure (e.g. in relation to aquaculture). However, implementation of several measures requires ship and port owners to incur additional expenses. Therefore, it is important to develop a national support system and implement it. Of the planned measures, the largest expenditures are expected to be incurred in relation to the introduction of LNG as ship fuel (see section 5.2.4).

To avoid marine pollution, it is important to improve navigational safety. Navigational safety relays upon, among other things, on the availability of bathymetry data that meet international norms and navigational information. Although improving navigational safety helps to achieve good marine environmental status, improving navigational safety has been set as an objective (with relevant defined measures) in another development document, which is the Estonian Marine Policy 2012–2020. The same document includes also the issue of developing ports (including small and fishing harbours) and related infrastructure. Consequently, the programme of measures does not address these issues.

In summary, the issues mentioned at the beginning of this section have been covered with the objectives and measures of the programme of measures or the Estonian Marine Policy 2012–2020 and the author of this report does not see any need to highlight any new potential topics that have not been discussed in the programme of measures.

5.2.9 Impact on marine cultural heritage

Estonia has a rich marine cultural heritage, be it values such as cultural property in the sea or the traditional coastal lifestyle. However, the coastal fishing tradition is fading away, work traditions and handicraft skills related to coastal living are fading away, and coastal landscapes are overgrown with shrubs or under strong construction pressure. In addition, there is a lack of resources to take an inventory of objects of cultural value and necessary activities to conserve them.

According to the analysis made in section 5.1 (Table 5.1), the measures of the programme of measures designed to improve seawater quality and cleanliness and maintenance of beaches and the coast have an overall indirect positive impact on the marine cultural heritage. Direct impacts are related to imposing of fishing restrictions that have an impact on the coastal fishermen and preservation of the coastal lifestyle as an important aspect of marine cultural heritage.

Imposing fishing restrictions may have a short-term negative impact on coastal fishermen and preservation of the coastal lifestyle as an important part of marine cultural heritage. At the same time, the fact that the main objective of the measure is to improve fish populations' reproduction capacity is important. In addition, it is important that the restrictions are developed locally or take into account the specifics of various regions. Consequently, although the measure may in short term have a negative impact, fishing is not banned entirely and traditional fishing can continue, although with some restrictions. What can be presumed is that not imposing additional restrictions may lead to a situation where traditional fishing activities disappear entirely because of the poor state of fish stocks. In a long-term perspective, imposing restrictions on fishing has a positive impact, because the status of fish stocks is expected to improve and the fishermen can continue with fishing. The measure "Promotion of realisation of low-value fish" included in the programme of measures can alleviated the short-term negative impact to certain extent.

Preservation of underwater and other sea related cultural objects is not directly related to the objective of the programme of measures. The issue is addressed in the Development Plan "Estonian Marine Policy 2012–2020".

In summary, the issues mentioned at the beginning of this section have been covered with the objectives and measures of the programme of measures or the Estonian Marine Policy 2012–2020 and the author of this report does not see any need to highlight new potential topics that have not been discussed in the programme of measures.

5.2.10 Cumulative impacts and cross-border influence

The measures have an overall positive environmental impact on the **natural environment**. Most of the measures have a positive cumulative impact. The effect of restricting excessive nutrients and control of eutrophication is present in the entire ecosystem and therefore the influence cumulates over time in the circulation of substances. It may also mean that the quantitatively measured effect has a time lag after the measures are applied. A cumulative positive impact accompanies also the measures that are related to the biota and habitats. Improving the biota conditions increases its reproduction capacity and this positive effect is cumulative over time. Negative impacts that cumulate in time may occur on the neighbouring areas of the future protected areas. It is necessary to make an analysis of these impacts after more details are made available about the future protected areas.

In addition to the cumulative impact over time, implementation of the programme of measures has also a positive concurrent cumulative impact on different components of the marine system. For example, by controlling the environmental risks associated with bunkering operations all ecosystem components are positively influenced.

A certain negative impact may be caused to the neighbouring areas of the new protected areas, but this is the only theoretical cross-border impact on the natural environment. The overall impact of the protected areas on the marine environment is positive. The measures will have positive impacts of varying degree on the components of the ecosystem that also influence the interactions of the same components. As the measures reduce the overall anthropogenic impact in the marine environment, there is no reason to think that influencing with varying degree would cause a significant negative environmental impact.

Most of the measures included in the programme of measures have a positive impact on the well-being and health of humans in the **socio-economic environment**. The impact is mainly related to the fact that as the result of the implementation of the measures seawater and air quality improves, generation of marine litter reduces and the pollution control capacity increases. The impact will be clear for the people that live on the coast as well as tourists (as regards air quality, also crew members) whose everyday lives are linked to the sea or who use the sea for recreational purposes.

The cumulative negative impacts on the socio-economic environment are related to the additional expenses that port and ship owners incur upon implementation of several measures (e.g. with introduction of LNG as ship fuel). It is important to develop a national support system and implement it.

Negative impacts occur for professional fishermen in case of imposition of various fishing restrictions and optimising of catching capacity. Imposing fishing restrictions may cause a negative impact on the coastal fishermen and on the preservation of the coastal lifestyle as an important part of marine cultural heritage. At the same time, it is important that the main objective of the measure is to improve the reproduction of fish populations. In addition, it is important that restrictions are worked out in every region and so that they take into account the specifics of various regions. Hence, although fishing restrictions may in short term have a negative impact, fishing is not entirely banned and the traditional fishing can continue, although with some restrictions. If the measures are not implemented, the reduction of important commercial fish stocks would continue which in turn will have a negative impact on the fisheries sector in long term. If the measures are implemented, a positive impact may be expected in long perspective, because the state of fish stocks is expected to improve, allowing to continue with fishing as a traditional business. The short-term negative impact may be alleviated with the measure “Promotion of realisation of low-value fish” to a certain extent.

Cross-border impact

The Marine Strategy Framework Directive specifies that the Member States shall identify the measures which need to be taken in order to achieve good environmental status by 2020. Although every Member State prepares its programme of measures individually, the objective of developing the measures is common for all Member States and therefore the improved marine environment status of one Member State will have a positive impact (at least in long term) on the marine environment of other Member States` marine areas. The programme of measures of Estonia has been prepared based on the Estonian marine area (includes inland sea, territorial sea and economic zone) and related marine environment. Consequently, the measures included in the programme of measures are, for the most part, implemented in Estonia and will have an impact primarily on the environment related to Estonian maritime industry. In addition to the improved Baltic Sea marine environment, in some cases there may occur cross-border impacts because some of the measures will apply to foreign ships that sail in the Estonian waters. Such measures are, for example, are *reduction of inputs from ships untreated wastewater, including ensuring reception of wastewater at ports*, *control of environmental risks that exist in relation to bunkering on sea* and *imposition of restrictions on vessel traffic in case of impact of waves.* Although implementation of the mentioned measures may cause certain changes in the existing system, they are necessary and are presumed not to cause any major negative cross-border impact. Generally, it may be presumed that because the objective of setting new measures of the programme of measures is to achieve good marine environment status, there will be a long-term positive cross-border impact. An activity that theoretically has a cross-border negative environmental impact may occur when protected areas are established, if this causes major changes in the routing system in the region. This may then lead to a situation where routing is directed past the protected areas and if an accident happens on the new route with a leakage of fuel or oil, then the pollution from the new route may be carried with currents over the border of Estonia`s economic zone. It must be stressed that this is a theoretical cross-border impact that should be considered when the protected areas are established if it causes shifting routes outside the protected area. The overall impact of the protected areas in the Baltic Sea environment is positive.

6. DESCRIPTION OF MONITORING REQUIREMENTS AND FOLLOW-UP ASSESSMENT

Environmental monitoring is a constant observation of environmental status and factors influencing it that includes environmental observations and analyses and processing of monitoring data.

In order to assess the actual environmental impact of the measures that are designed to achieve the objectives of the programme of measures, it is necessary to conduct assessment/analysis of the quality of environmental components periodically. The monitoring and follow-up of the programme of measures must give information on how any implemented measure has influenced various environmental components. At the same time, implementation of the planned measures influences also the socio-economic environment. Hence, it is not only necessary to gather data on the natural environment and environmental pollution, but also on the social and economic environment. The authority that will gather and analyse monitoring data is the authority that initiates preparing of the programme of measures and approves the programme, i.e. the Ministry of the Environment in cooperation with other competent authorities.

6.1 Natural environment

The efficiency of the planned measures must in most cases be clear from the indicators of GES descriptors. The indicators according to which GES was not achieved by the assessment made by Estonian Marine Institute of Tartu University (2012b) are primarily of interest.

1. Measure 1 is mainly related to the descriptor “Biological diversity” which is why the efficiency of the measure should be assessed based on the indicators of the relevant descriptor. It is not necessary to conduct additional monitoring besides the presented monitoring programme (TTÜ Meresüsteemide Instituut, 2014).
2. Measure 2 is more specific and designed to protect the ringed seal. The efficiency should be primarily assessed by indicators 1.1.1.2 (The ringed seal range), 1.1.2.2 (The ringed seal type of distribution), based on what GES has not been achieved, and 1.2.1.2 (The ringed seal abundance) that was not yet applicable as of 2012. It is not necessary to conduct additional monitoring besides the presented monitoring programme (TTÜ Meresüsteemide Instituut, 2014).
3. Measure 3 is preventive in nature, which is why monitoring indicators are not presented currently. It is possible to establish monitoring requirements after it is clear where and to what extent aquaculture operations will take place.
4. Measures 4 and 5 are designed for the descriptor “Non-indigenous species” and its efficiency should be assessed based on the indicators of the relevant descriptor. It is not necessary to conduct additional monitoring besides the presented monitoring programme (TTÜ Meresüsteemide Instituut, 2014).
5. Measures 7 and 8 are designed for the descriptor “Fisheries”. The efficiency of the measures should be clear based on the indicators of the relevant descriptor, of which most indicated that as of 2012 GES was not achieved. The measures may also cause a certain positive effect on the indicators of the descriptor “All elements of the marine food webs, to the extent that they are known, occur at normal abundance and diversity and levels capable of ensuring the long-term abundance of the species and the retention

of their full reproductive capacity" that mostly show that GES has not been achieved. It is not necessary to conduct additional monitoring besides the presented monitoring programme (TTÜ Meresüsteemide Instituut, 2014).

6. Measures 10 and 11 are designed mainly for the descriptor "Human-induced eutrophication" and the efficiency of the measure should be assessed based on the indicators of the relevant descriptor. It is suggested to improve the monitoring programme regarding the eutrophication indicators and the physical parameters that influence it as described in section 5.2.3. Tallinn University of Technology Marine Systems Institute (2014) has given this suggestion regarding some parameters in its work, although monitoring is not currently conducted to the presented extent. Near larger settlements, the impact of measure 11 may be seen in the reduced amounts of marine litter. Currently there does not exist a functioning indicator, but the indicator "Amounts of marine litter gathered during coast cleaning" offered in the programme of measures for assessment of measures 11 may be considered.
7. Measure 12 is designed for the descriptor "Alternation in hydrology" that did not have any functioning indicators in 2012. As the impact of the measure is related to the reduction of abrasion caused by ship-generated waves, the efficiency should be assessed within the framework of marine monitoring. A potential indicator (presented in the programme of measures "extent of erosion caused by ship traffic has been proved") can be specific to the location because in the Estonian marine area Tallinn Bay is currently under the impact of high-speed craft generated waves.
8. Measures 13 and 14 are designed for the indicator "Contaminants in water". As the intention of this measure is to control oil contamination from ships, we suggest to use a parameter that directly describes the frequency and extent of oil pollution detected on the sea for monitoring purpose. For example, the PF (Pollution per Flight) index may be used that shows the number of spills per every flight hour. Such monitoring is already conducted in the Estonian marine area and statistics are gathered; hence, no additional monitoring is necessary;
9. Measures 15, 16, 17, 18, 19 and 20 are designed for the descriptor "Marine litter". Currently no national monitoring is conducted of marine litter and there are no functioning indicators. We suggest to consider (at least partly) using the indicators of marine litter suggested in the programme of measures as GES indicators. To assess the efficiency of measures monitoring of indicators should begin before implementation of measures.
10. Measure 21 is designed for the descriptor "Marine noise and energy". The measure is the first step at national level to address the issue of noise in Estonian marine areas. The monitoring programme will be developed during the implementation of the measure, if necessary.

6.2 Socio-economic monitoring of implementation of measures of the programme of measures

We suggest to gather periodically additional socio-economic data (in addition to the indicators given in the measures of the programme of measures) in relation to the implementation of the measures planned in the programme of measures:

- Catching capacity;
- Amounts of fish by regions and by species of commercial fish;
- Number of professional fishermen;

- Number of companies that realise low valued fish as by-catch of commercial fishing, volume of realised fish;
- Number and location of ports in Estonia that can supply ships with LNG fuel;
- The total number of ship accidents and hazardous incidents;
- The number of companies that are involved in offshore aquaculture and the number and list of aquaculture facilities;
- Number of ports with the capability of marine pollution control;
- Number and list of ports where reception capacity of wastewater from cruise ships is ensured;
- Number of stormwater treatment systems that are built to direct stormwater straight into the sea;
- Number and list of ports where marine litter reception system has been developed.

The data should be gathered and analysed at least once in four years, and, if possible, annually.

7. OVERVIEW OF THE SEA PROCESS AND ENCOUNTERED DIFFICULTIES

The strategic assessment of the programme of measures to achieve or maintain good environmental status of the Estonian marine area was initiated by Decree No. 342 of 8 April 2015 of the Minister of the Environment (SEA programme Annex 1). The SEA is conducted in accordance with the *Environmental Impact Assessment and Environmental Management System Act* (in effect until 30 June 2015 (the transitional provision applicable until 1 July 2018).

The Ministry of the Environment is the authority that has initiated the preparation of the programme of measures and has adopted it. The programme of measures is prepared by Stockholm Environment Institute Tallinn Center (Säästva Eesti Instituut), Estonian Marine Institute of Tartu University Tartu Ülikooli Eesti Mereinstituut) and Marine Systems Institute at Tallinn University of Technology (Tallinna Tehnikaülikooli Meresüsteemide Instituut). Eesti Keskkonnauuringute Keskus OÜ is responsible for organising the preparation of SEA and the assessment is prepared by Alkranel OÜ and Marine Systems Institute at Tallinn University of Technology.

The Ministry of the Environment, the Ministry of Economic Affairs and Communications, the Ministry of the Interior, the Agricultural Board, the Ministry of Education and Research, the Ministry of Social Affairs, the Environmental Board and the Estonian Maritime Administration were asked to express their opinion on the content of the draft SEA programme with a letter of 17 June 2015. Due to the potential environmental impact of the SEA programme, Finland, Sweden, Russia, and Latvia were asked to express their opinions regarding the draft SEA programme. Poland, Denmark, Germany and Lithuania were also informed about the SEA. Finland and Latvia expressed their intention to participate in the process and Poland requested to be introduced the final version of the SEA report. The opinions and how they were taken into account are presented in Annex 3 to the SEA programme.

The SEA programme was displayed publicly 13.07–27.07.2015 on the web site of the Ministry of the Environment http://www.envir.ee/et/merestrateegia and the web site of Eesti Keskkonnauuringute Keskus http://www.klab.ee/merestrateegia/uudised/**.** Publication of the programme was notified in the publication Ametlikud Teadaanded (http://www.ametlikudteadaanded.ee**,** 10.07.2015) and in the newspaper Postimees (11.07.2015). The information was also posted to the news section of the Internet home pages of the Ministry of the Environment (http://www.envir.ee/et/merestrateegia/), Eesti Keskkonnauuringute Keskus OÜ (http://www.klab.ee/merestrateegia/uudised/) and Alkranel OÜ (http://www.alkranel.ee/). An e-mail about the publication of the draft SEA programme (including public discussion) was sent to the interested persons and authorities on 9 July 2015 by Eesti Keskkonnauuringute Keskus.

The public discussion of the SEA programme was held on 27 July 2015 at 10 a.m. in the premises of the Ministry of the Environment (Narva maantee 7a, Tallinn 15172). During the public display of the SEA programme, opinions were sent by the Health Board and the Ministry of Agriculture, which are presented in Annex 5. The SEA programme was approved by letter No. 11-2/15/5029-14 of 12 October 2015 of the Ministry of the Environment (Annex 2).

8. SUMMARY OF SEA RESULTS

The object of this strategic environmental assessment (hereinafter SEA) is the Estonian Marine Strategy`s programme of measures to achieve and maintain good environmental status of the Estonian marine area. The relevant SEA was initiated by Decree No. 342 of 8 April 2015 of the Minister of the Environment.

The purpose of preparing the programme of measures is to identify measures that must be taken in the Estonian marine area in order to achieve or maintain good environmental status and to reach the set environmental targets. The cost-efficiency and technical feasibility of the measures shall be ensured and prior to adoption of a new measure, impact assessments shall be conducted, including analysis of revenue and expenditure. When preparing the programme of measures, the impact that the measures will have on the waters outside the relevant marine area must be taken into consideration to minimise damage and, if possible, have a positive effect on the relevant waters. According to Article 5 of the Marine Strategy Framework Directive (MSFD), the Member States shall develop a programme of measures by 2015 at the latest and the programme has to enter into operation by 2016. The description of the new measures (version 15.09.2015) presented in the draft programme of measures is included in Annex 3.

The objective of the SEA is to identify, describe and assess the possible material strategic environmental impact accompanying the implementation of the new measures planned in the programme of measures and offer measures that alleviate the negative environmental impact and/or avoid it or amplify the positive impact. Another objective is to assess the internal correspondence of the measures developed in the programme of measures and connections with national and international environmental objectives. The SEA is conducted in accordance with the *Environmental Impact Assessment and Environmental Management System Act* (in effect until 30 June 2015 (the transitional provision applicable until 1 July 2018).

The Ministry of the Environment is the authority that has initiated the preparation of the programme of measures and has adopted it. The programme of measures is prepared by Stockholm Environment Institute Tallinn Center (Säästva Eesti Instituut), Estonian Marine Institute of Tartu University (Tartu Ülikooli Eesti Mereinstituut) and Marine Systems Institute at Tallinn University of Technology Tallinna (Tehnikaülikooli Meresüsteemide Instituut). Eesti Keskkonnauuringute Keskus OÜ is responsible for organising the preparation of the SEA and the assessment is prepared by Alkranel OÜ and Marine Systems Institute at Tallinn University of Technology (Tehnikaülikooli Meresüsteemide Instituut).

The draft SEA programme was displayed publicly 13.07–27.07.2015 and the public discussion was held on 27 July 2015. The SEA programme was approved by letter No. 11-2/15/5029-14 of 12 October 2015 of the Ministry of the Environment (Annex 2).

8.1 OVERVIEW OF THE CURRENT SITUATION, PROBLEMS AND PRESSURES

8.1.1 Overview of the natural environment

The report “Initial Environmental Assessment of the Estonian Marine Area” about the status of the marine areas under the jurisdiction of Estonia was prepared in 2012 (TÜ Eesti Mereinstituut, 2012). This section has been prepared based on this report and supplemented with information from other sources, if necessary.

Bathymetry, characteristics of sea floor and coast

The Estonian marine area includes three subareas of the Baltic Sea – the Gulf of Finland, the Gulf of Riga and offshore Baltic Sea where the characteristics of coasts as well as bathymetry greatly varies. In the south-eastern part of the Gulf of Finland (Narva Bay) the sea is mainly 20–40 metres deep, in the western part the sea is relatively deep. The seafloor topography is characterised by shallower and deeper areas (over 100 m deep). The open sea of the western islands has a varied coastline (bordering with western Estonia islands) and in the coastal sea mainly 10–40 m deep, although deeper in the territorial sea and economic zone outside it.

Estonian coastline is very diverse. According to Kaarel Orviku (1993) classification, there are eight types of coasts in the Estonian coastal sea: cliff shore, scarp shore, rocky shore, till shore, gravel shore, sandy shore, silty shore, artificial shore (artificial facilities – breakwalls, quays and protective walls).

The most frequent seafloor reliefs in the Estonian marine area outside the coastal sea are muddy or clayey plains and valleys.

Temperature, salinity, stratification, ice cover

Temperature and salinity define largely the characteristics of a region`s ecosystem, including species composition. The temperature and salinity fields of the Baltic Sea are highly variable both in time and space which is caused by complex topography, strong horizontal and vertical gradients and major atmospheric variability in different temporal scales, i.e. long-term trends, changes between years, seasonal cycle and synoptic variability.

The density and stratification of seawater depend mainly on the variability of temperature and salinity described above. If we study the hypsographic curve of the Estonian marine areas, it shows that around 20% of the Estonian marine area is so shallow that it should be mixed from the surface to the bottom most of times, that 50% of the Estonian marine area is temporarily stratified and around 30% of the marine area is deeper than 60 m that allows the presence of the halocline, i.e. there is a high probability that in this part the water column is stratified all year around.

Ice cover on the Baltic Sea may be very different every year. In shallow and half-closed bays, ice may cause hypoxia. Abundance of ice is mainly dependent on how harsh the winter is that in turn depends on the atmospheric circulation. Ice is an important factor that influences vessel traffic, processes that occur in ports and on the coast. Difficult ice conditions increase the frequency of shipping accidents. Thick ice cover and/or ice pressure caused by strong wind may leave ships icebound.

Currents, wave regime and sea level

Characteristic current velocity in the surface layer of the Estonian marine area is 10–20 cm s^{-1}. At the same time, currents are very changeable and depend largely on local wind.

As characteristic to stratified estuaries, inflow from offshore Baltic Sea to the gulf dominates in demersal layers (deeper water layers), whereas outflow from the gulf dominates in the upper layers. Strong southwestern winds can temporarily reverse this circulation scheme, i.e. outflow dominates in deeper layers and inflow in the upper layer. The central circulation of the Gulf of Riga is also cyclonic, as in other Baltic Sea basins. Significant differences between the Gulf of Riga and high seas of the Baltic Sea and offshore part of the Gulf of Finland is that the Gulf of Riga is separated from the high seas by thresholds in straits and exchange of water occurs there through quite narrow straits (the Irbe strait (Kura kurk) and the Suur väin strait) and that the gulf mixes to the bottom during the autumn-winter storms.

The significant wave height (for the period of 2001−2007) has been over 2 m in the offshore Baltic Sea (in the Estonian marine area), over 1.5 m in the open sea of the Gulf of Finland and 1.0−1.5 m in the open sea of the Gulf of Riga. The average wave height in the coastal sea is significantly lower.

The long-term change of water level in the Estonian coastal sea is primarily related to the slow land uplift in the region and the long-term change in the world sea water level. Due to the seasonal nature of winds in the Baltic Sea region, the high water levels are more frequent in autumn and winter. An important aspect in terms of ship connection with the mainland is low levels of water. This is especially important on Rohuküla-Sviby and Rohuküla-Heltermaa waterways.

Nutrients and oxygen

Nutrients, such as nitrogen and phosphorus, are necessary for the production of phytoplankton, macrophytes and bacteria in the sea. Long-term changes in nutrients is related to nutrient input to and output from atmosphere, rivers, neighbouring areas and sediments, and consumption.

As regards nitrogen, somewhat lower values have been registered in recent years in the Gulf of Finland. As for phosphorous, the values have been bigger in recent years. It is likely that the increase in the content of phosphorous in the Gulf of Finland is not directly related to the growth of inflow from rivers and pollution sources. As in coastal waters, the average total phosphorus in the offshore Baltic Sea has been growing. The total nitrogen content was relatively stable in 1993–2003 but in recent years a growing trend has been seen. The nutrient regime of the Gulf of Riga differs considerable from the other parts of the Baltic Sea, the total nitrogen and phosphorous values compared to the offshore Baltic Sea are double. The long-term trend of the open sea area of the Gulf of Riga is characterised by an increase in the concentration of total nitrogen, but concentrations of total phosphorus, regardless of low average indicators measured in 2010, show a growing trend in all monitoring stations.

Deficiency of oxygen in the bottom layers in the entire Baltic Sea is an acute topic. Although hypoxia is a natural phenomenon in the Baltic Sea, it is believed that the extent of hypoxia is a result of anthropogenic eutrophication, at least partly. Hypoxia is present in the deeper layers of the Estonian offshore areas (offshore part of the Baltic Sea, in the Gulf of Finland and in the Gulf of Riga) and in the coastal zone in areas of high trophicity.

Plankton

Phytoplankton

The most important factor that influences phytoplankton is enriching the marine environment with nutrients, or eutrophication. The increase of nutrient concentrations in seawater causes intensive algae blooms, or growth of phytoplankton biomass.

According to the HELCOM (2009b) thematic report, the most eutrophic offshore areas, such as the Gulf of Finland and the Gulf of Riga and the northern part of the Baltic Sea, are located along the Estonian coastal waters. Based on the results of operative and general monitoring of the Estonian coastal waters and the assessment system established in Estonia, most of the coastal waters are considered to be in poor condition. An exception is the most eastern and western waters, i.e. the Narva Bay and the Kihelkonna Bay, which condition is good based on the state of phytoplankton. Of the Estonian coastal waters, the Haapsalu Bay is in the worst ecological state.

Zooplankton
Zooplankton is an important link in the marine food chain, because juvenile fish stages feed on it.

Zooplankton communities are very varying and respond quickly to changes (e.g. water salinity and climate change) in the ambient environment. Relatively recently it has been proved that there are links between some zooplankton species and phosphorus and nitrogen concentrations of seawater (Põllumäe and Kotta, 2007; Põllumäe *et al*., 2009). Based on the existing studies, some zooplankton species respond to eutrophication of seawater (Põllumäe and Kotta, 2007; Põllumäe *et al.*, 2009). Currently, there are no indicators that help assess the marine environment condition based on zooplankton in the Baltic Sea.

<u>Benthos</u>

Phytobenthos
The Baltic Sea brackish water is an extremely complicated environment for sea plants because of varied salinity conditions, different coast types and substrates and other environmental conditions, which is also the reason for relatively low diversity of the Baltic Sea phytobenthos.

Plants grow up to 5–6 m deep on the soft seafloor in the Estonian coastal sea. The deepest areas are usually inhabited by charophyte communities. At depths lower than 1 m phanerophytes dominate.

Phytobenthos has been used as a means to assess water quality for a long time. Based on the aggregate index of phytobenthos, the condition of most Estonian coastal waters can be given a good score. This index also shows that the Haapsalu Bay is in a poor condition and the Matsalu Bay is in the worst condition.

Zoobenthos
The range patterns of zoobenthos communities in Estonian coastal sea depend on the region`s hydrology, characteristics of sediments, in shallower coastal waters also the phytoplankton content in the water column, the character of phytobenthos communities and influence of ice.

The crustacean (*Crustacea*) species are most widespread in the Estonian waters. In addition to crustaceans, the typical zoobenthos of the Estonian marine area includes seawater and brackish water clams (*Bivalvia*), snails (*Gastropoda*) and worms (*Polychaeta*). Hydrozoans (*Hydrozoa*), ribbon worms (*Nemertini*), priapulid worms (*Priapulida*), marine and brackish water oligochaetes (*Oligochaeta*), moss animals (*Bryozoa*), marine and brackish water snails (*Gastropoda*) and clams (*Bivalvia*) can be found in our marine area. Relatively often, the zoobenthos includes four fresh water species of snails and five fresh water insect groups.

Above the halocline, the range of benthic communities is determined by three main factors, which are salinity, depth and type of seabed. Local factors are competition between species and, lately, human impact.

To assess the water quality in waterbodies using zoobenthos, Estonian Marine Institute of Tartu University has developed the zoobenthos community index ZKI, the hard bottoms index KPI and the habitat diversity index of phytobenthic zone FDI. The environmental condition of waterbodies calculated by the values of these indexes was good for the entire Estonian coastal sea in 2008–2010.

The main pressures that influence the condition of the benthos are marine environment eutrophication, invasion of non-indigenous species and oxygen deficiency in deep sea.

Fish fauna

Highly migratory species

The only catadromous species in the Estonian waters is the eel. The stock of the European eel is at low levels and eel fishing is not sustainable. The reason given is small number of spawners (Dekker, 2003), which indicates overfishing in the entire range of the species. The abundance of the eel is negatively influenced by dams that have been built on the migration rivers causing late migration or mortality (Bruijs and Durif, 2009).

The representatives of anadromous species are the salmon and the sea trout. The number of allowed sized salmon in the Estonian coastal sea depends on the catch of salmon originating from Estonia outside our economic zone. According to prognoses, the catches will remain on the same level in near future (Kesler *et al*., 2011). Sea trout catches during 1999–2010 have shown a slight growing trend. It must be taken into account, that salmon and sea trout catches include introduced fish. An important factor that causes reduction in the numbers of anadromous species is dams on spawning rivers that block access to the spawning grounds. The success of reproduction is influenced by the water level on the spawning rivers during the autumn and winter period.

Coastal sea fish

The coastal sea fish group includes marine species, such as eelpout, sea stickleback, broadnosed pipefish, straightnose pipefish, rock gunnel, lesser sandeel, great sand eel, black goby, sand goby, common goby, two-spotted goby, and longspined bullhead. Fish that inhabit the Estonian part of the Baltic Sea of freshwater origin can be classified as belonging to the coastal sea fish group. The abundance of large species is relatively low, fishing pressure is moderate, but still very different depending on the particular species (Saat *et al*., 2011). An exception is the non-indigenous species Prussian carp and the round goby that are strongly expanding their range (Eschbaum *et al.,* 2011; Ojaveer *et al*., 2011). The factors that reduce the abundance are fishing mortality rate, pressure by cormorants, hydrometeorological factors as well as overgrown spawning grounds (Saat *et al*., 2011; Vetemaa *et al*., 2010).

Demersal fish species

These are species which range extends outwards of the shallow coastal area. The European flounder and the Atlantic cod are the main species in the Estonian waters that are of a commercial interest. For the Atlantic cod, a pressure in the eastern part of the Baltic Sea is primarily hydrological processes, such as water exchange with the North Sea (HELCOM, 2006). In the Estonian waters, the European flounder is able to spawn in areas close to the coast with lower salinity (Ojaveer and Drevs, 2003), but their reproduction is more successful following an inflow of salty water. The monitoring data show that the stock of the European flounder has decreased in all the largest areas of the Estonian coastal sea, although the fishing mortality rate can be considered moderate. The reason for the reduction of their stock is the deteriorating situation in flounder spawns (Saat *et al*., 2011).

Pelagic species
In the Estonian waters, the typical small size pelagic species are the Baltic herring and the sprat. Spring Baltic herring abundance in the Gulf of Riga is still high (although showing a decreasing trend), but in other sea areas low. Autumn Baltic herring is still in deep depression. The Baltic herring stock in the Estonian economic zone can be considered relatively good.

In addition to the Baltic herring and the sprat, an abundant species in the pelagic zone is the three-spined stickleback. Sometimes random visitors (e.g. also the European anchovy) can be found here. Seasonally the garfish is abundant in the Estonian waters.

Cyclostomes
There are two species of cyclostomes in the Estonian waters: the European river lamprey and the sea lamprey, whereas the latter is found very seldom. The condition of the European river lamprey is significantly better than in the rest of Europe.

The main pressures on the fish fauna are fishing mortality rate, destruction and declining conditions of habitats and spawning grounds and hydrometeorological conditions.

Wild birds
Most bird species in the north-western Europe, including the Estonian marine area, are migratory birds and the range and abundance of these species is mostly influenced by factors outside Estonia.

Over 40 bird species nest in the Estonian coastal areas and on inlets, of which many species gather into nesting colonies. Even more birds gather outside nesting period forming moulting sites. Seabirds moulting colonies are located on offshore banks (the common scoter, the common eider) as well as in the coastal sea (the common goldeneye, the dabbling ducks, the mute swan, the greylag goose etc.). The autumn migration of birds from the Arctic nesting grounds begins already in the middle of summer and lasts until the end of October. A remarkable congregation of seabirds happens in spring (spring migration) after melting of ice when in addition to the wintering birds other species wintering elsewhere fatten themselves here, such as the long-tailed duck, the scoter, the swan, the goose and the black goose that head on to nest in the tundra.

The trends discovered in the work performed for the initial assessment of the Estonian marine areas (TÜ Eesti Mereinstituut, 2012) show great changes in the numbers of wintering waterbirds during the recent 15–20 years.

An important component in assessing the Estonian marine area status is the diverse composition of breeding bird species on inlets and in the coastal areas. Breeding birds like wintering birds are stationary for a long time, which means that they are greatly influenced by local pressures.

The main pressures on birds are eutrophication, by-catching and oil pollution.

<u>Protected natural objects and Natura 2000</u>

Protected natural objects

According to § 4 of the *Nature Conservation Act*, the protected natural objects in Estonia are protected areas, limited-conservation areas, protected species and fossils, species` protection sites, individual protected natural objects and natural objects protected at the local government level.

As of 31 December 2014, there was altogether 3,895 protected natural objects in Estonia. According to the EELIS database (19.09.15), in Estonia there are:

- 343 limited-conservation areas, of which 57 include a part of the sea. In the Estonian waters, the largest limited-conservation areas are Väinameri (Hiiu, Saare, Lääne County), the Pärnu Bay and Kura kurk limited-conservation areas.
- 149 nature conservation areas, of which 23 include a part of the sea;
- 149 landscape conservation areas, of which 31 include a part of the sea;
- 5 national parks, of which 3 include a part of the sea (Vilsandi, Matsalu and Lahemaa)
- 1,380 species protection sites, of which 11 include a part of the sea.
- 570 protected plant, fungi and animal species, of which:
    - marine mammals are the grey seal (category III) and the ringed seal (category II) and the harbour porpoise (category III);
    - waterbirds are the white-tailed eagle (category I) that feeds on fish and water birds. II category species are the Eurasian bittern, the tundra swan, the whooper swan, the greater scaup, the Steller's eider, the smew, the little gull, the lesser black-backed gull, the razorbill and the black guillemot;
    - fish are the European sea sturgeon, the spined loach, the bullhead (category III).

Natura 2000 areas

Of Natura 2000 areas, 89 nature and bird areas have also a sea part. Of these, 26 are bird areas with a sea part with an area of about 6,500 km^2 and 63 nature areas with a sea part with an area of about 3,900 km^2. The largest of Natura areas are Lahemaa and Väinameri nature and bird areas and the Pärnu Bay and Kura kurk bird areas (EELIS (Eesti Looduse Infosüsteem - Keskkonnaregister): Keskkonnaagentuur, 15.09.15). All nature and bird areas that have a sea part are in the territorial sea. There are no Natura areas in the economic zone.

According to the EELIS database (18.09.15), there are altogether 62 valuable habitat types on the Natura nature areas in Estonia. According to the "Manual of Nature Directive Habitat Types" (Paal, 2007), six of these are marine habitats. Several species included in Annex II of the Nature Directive inhabit Estonian seawaters whose habitats are protected. Of species represented in Estonia, in addition to migratory species and other species of local importance, 65 species belong to Annex I of the Bird Directive. Estonia has to take into consideration about 90 species when selecting bird areas (Natura 2000, 16.09.15).

The main risk factors of marine habitat types are construction works in the marine area, for example, construction of ports and windfarms and establishing waterways, but also excavation of mineral resources, marine pollution and eutrophication of the marine environment, but also overgrowing and drainage (Keskkonnaamet, 2009, 2011, 2012). The main pressures on the ringed seal and the grey seal are disturbance by humans, poor state of fish stocks, being killed in fishnets (Keskkonnaamet, 2011; Eesti Mereinstituut, 2012). Land habitats may be endangered by poor management or lack thereof; for example, suspension of grazing or no grazing that may result in overgrowing (Keskkonnaamet 2011b, 2012b). Aquatic birds are threatened by oil pollution, ship and motor boat traffic, disturbance during their breeding period, changes in food base in bird areas (Keskkonnaamet, 2009, 2012).

Deficiencies

In Estonia, various data sources are available about protected natural objects, including habitat types and species on the Natura areas. It is often the case that valuable data on the habitats and biota (range, area, status, risk factors etc.) are included in different reports that have been prepared during various projects carried out in Estonia, but the Estonian official database EELIS (Estonian Nature Information System) does not include these data. Scattered valuable and important data makes it difficult for nature experts to work and slows down their progress.

Marine mammals

There are three endemic species of marine mammals in the Estonian coastal waters: the grey seal (*Halichoerus grypus*), the ringed seal (*Phoca hispida*) and the harbour porpoise (*Phocoena phocoena*).

The grey seal is a very migratory species whose range is primarily linked to their habitats. The range during the breeding period is linked to the presence of ice during that period (February–March). The main breeding grounds are located on the western and southern coast of Saaremaa, the eastern and central part of the Gulf of Finland, and more seldom in the northern coastal waters of Hiiumaa in normal and milder than average winters.

The status of the population of the Baltic Sea grey seal population that inhabits the Estonian coast has constantly improved over recent decades. Due to a great decrease in abundance, hunting of grey seals was prohibited in Estonia in 1972 (Keskkonnaamet, 06.09.2015).

In Estonia, ringed seals live mainly in Väinameri and the Gulf of Riga, and less frequently in the Gulf of Finland. The known resting grounds are in Väinameri and in the northern part of the Gulf of Riga on the banks near the coast. Their breeding grounds are mainly in the Pärnu Bay and the northern part of the Gulf of Riga. Distribution during breeding time depends on the existence of suitable ice types. The ringed seal population status can be considered unstable.

8.1.2 Pressures on and status of the natural environment

- **Physical damage: siltation, sealing, elimination, smothering, changing the coastline**
  Dredging and excavation can have material impacts on the coastal processes, water column light field, distribution of nutrients, plankton, benthos and fish fauna. The impact on the biota is estimated to last up to two years.

- **Underwater noise**
  Noise created by ships and hydrotechnical and explosion operations has a negative impact on fish fauna and marine mammals. Currently, there is no data to determine the quantitative impact for the entire Estonian marine area.

- **Enrichment with nutrients**

As discharges of nitrogen and phosphorus-rich substances is the main cause of eutrophication of the Estonian coastal sea, the status assessment of the existing marine environment (TÜ Eesti Mereinstituut, 2012) clearly shows that the inflowing nutrient amounts are too large for the Estonian coastal sea and the status is considered unsatisfactory based on this indicator.

- **Inputs of organic matter**
  The condition of the Estonian coastal waters based on the input and content of organic matter is not good in most areas. Hence, it is necessary to limit not only nutrient inputs but also organic substance inputs into the coastal sea. It is also reasonable to broaden monitoring for more precise detection of organic substance.

- **Introduction of microbial pathogens to waterbodies**
  The most significant source of pathogenic bacteria in Estonia is the fast-growing cruise ship operating sector and still insufficient organisation of wastewater (sewerage) treatment originating from cruise ships. As cruise ships discharge partly treated sewerage mainly into international waters, it does not have a direct impact on the microbiological quality of the Estonian coastal waters. As the bathing season in Estonia is relatively short, the sea temperature cool and usually healthy people go bathing, the microbiological load on waters is local and small, and possible pathogen load unlikely (TÜ Eesti Mereinstituut, 2012).

- **Contamination by hazardous substances**
  The status of the Estonian marine area in terms of hazardous substances is average and poor according to HELCOM (2010b) data. However, the content of hazardous substances is not generally in conflict with the main objective of environmental quality specified in the EU norms – the contents of hazardous substances must not significantly increase over time. A positive indicator is that the concentrations of hazardous substances in the Baltic Sea marine environment are decreasing. A decreasing trend is also seen in the content of radioactive substances, although the indicator has not yet dropped to the level before the Chernobyl nuclear power plant disaster.

- **Marine litter**
  As the largest part of marine litter is generated on land and it can be presumed that using plastic (including packaging) continues to increase in future, it is important to focus on improving the awareness of people about marine litter and compliant handling of waste.

- **Oil pollution from ships and its impact**
  Due to intensive waterborne traffic and significant and extensive impact of oil pollution on the marine environment, oil products leaked into sea due to ship accidents is the largest environmental pollution risk in our marine area.

- **Selective extraction of species**
  For many fish species, the fishing mortality rate is very high. Birds and marine mammals also die due to fishing activities. Selective catching of species is an important pressure on the marine environment.

- **Introduction of non-indigenous species**

In the Baltic Sea, shipping is the most significant entryway for non-indigenous species that find their way through ship ballast water and by attaching to ship hulls.

- **Intentional or systematic release of solid substances into the marine environment**
  No known data has been published on the amount and nature of food wastes. A potential significant impact on the character of the sea bottom may be caused by erecting wind generators.

- **Status of natural environment**
  To describe the status of the marine environment, eleven qualitative descriptors of good environmental status are used (MSFD, Annex I). Good environmental status of the Estonian marine areas has been achieved only by some descriptors. For five descriptors, at least three indicators good environmental status has not been achieved. For three descriptors (descriptor 7 (Permanent alteration of hydrographical conditions does not adversely affect marine ecosystems), descriptor 10 (Marine litter) and descriptor 11 (Energy and noise)) no indicators exist for the Estonian marine areas.

8.1.3 Overview of socio-economic environment and problems

Business environment related to maritime industry
For the purpose of this SEA report, the business environment includes various infrastructures (electricity, gas) and related business as well as the development of shipping, fisheries, aquaculture, tourism and energy in the Baltic Sea.

Maritime industry plays an important role in the Estonian economy, because *ca* 60% of Estonian export and import operations are conducted by sea.

Infrastructure
Direct current connections with Finland have been established. In a longer perspective, it is possible to create a connection with Sweden and construct a third connection between Estonia and Finland that would ensure sale possibilities for the production of the perspective offshore windfarms. It is planned to synchronise the **power grids** of the Baltic States and the European Union. Converter stations need to be built on the state border (National Spatial Plan *"Estonia 2030+"*).

Transition to **natural gas** as the most clean fossil fuel requires the development of a necessary infrastructure, i.e. liquefied gas (hereinafter LNG) terminals and bunkering stations in the SECA region, including the Baltic Sea ports. Currently, there are terminals only near Stockholm and in Klaipeda. The plan is to connect the Estonian gas transfer network in addition to the existing transfer networks also to the Finnish gas market via Balticconnector (Ramboll Eesti AS, 2014).

Marine infrastructure problems are mainly related to intensifying construction of infrastructures into the sea where clearly is seen a relative growth of physical loss: smothering of seafloor, sealing and growth of underwater noise due to construction works.

Shipping industry
The annual overview of the ship register prepared by the Estonian Maritime Administration shows a big drop in the number and gross tonnage of bareboat charted cargo vessels. In addition

to changes in the number of bareboat cargo vessels, the number and tonnage of fishing ships has dropped almost by half. The number of passenger ships that sail under the Estonian flag has been quite stable compared to the data of 2003.

From 1 January 2015, all ships that sail on the Baltic Sea must use fuels with sulphur content < 0.1% or be equipped with treatment facilities that ensure SO_x content reduction to the required limit in exhaust gases. Currently, only a few LNG fuel ships sail on the Baltic Sea. However, a very quick growth in the number of LNG-ships is not foreseen in near future, because facilities for supplying ships with LNG in ports, except for in Norway, are non-existent or limited.

The Estonian shipping sector is part of the world and the Baltic Sea shipping, which is why it is important to ensure the Estonian shipping companies equal competitive conditions at least with neighbouring countries. This means bringing into line of ship operating costs with those of the competitors as well as improving administrative activities related to ship operating. Moreover, the system should be long-term to ensure companies certainty so that they are ready to make investments. Trawlers must also be taken into account. According to the "*Marine Sector Overview 2013"*, common fairway dues were imposed from 1 July 2013 with the amendment of the *Maritime Safety Act* that ensures more streamlined principles to stay in competition with the neighbouring countries.

Shipbuilding and repair

There are three weaknesses that limit the development of the ship-building sector: lack of qualified labour, no infrastructure to build and repair large ships year around and limited investing capacity. The state can support entrepreneurs through cooperation that targets renovation of the state-owned fleet. As the competitive edge of Estonian companies is mainly building of special and more complex ships and providing technological updates and flexibility in fulfilling orders, they have to offer new and innovative solutions. However, entering the market with a new product is complicated, because potential buyers need certainty that these products function. During the renovation of the state`s fleet, it is possible to take into account new solutions offered by our entrepreneurs that would give them an opportunity to demonstrate the operational reliability of their products and give a reference for potential foreign clients (Eesti merenduspoliitika 2012–2020, 2011).

Tourism

The main resource of the Estonian marine tourism is the nature that has not been influenced very much by human activity and offers varied landscapes and diversity of species and a long coastline with over 1,500 islands and inlets.

According to the Estonian National Tourism Development Plan for 2014–2020 (2013), the routes of international shipping lines are overly concentrated around Tallinn and it is necessary to extend them to other coastal regions and islands (e.g. Kunda, Sillamäe, Saaremaa). In addition, to develop marine tourism, it is necessary to improve the awareness of neighbouring markets about marine tourism products and services offered on the Estonian coast and islands and about local recreational opportunities.

Fisheries

According to Statistics Estonia, deep-sea fishing on the Baltic Sea accounted for 75–90% of the total fishing activities on the Baltic Sea in 2000–2010. The most caught species are the Baltic herring and the sprat and the percentage of these fish in the total catch numbers exceeds 95%.

The main coastal fishing regions are the Pärnu Bay, Väinameri and the Gulf of Finland. Many different species are caught, of which economically more important are the perch, the Baltic herring, the smelt, the zander, the flounder, and the eel. The garfish and the sea trout are also important species, whereas the salmon and the pike are caught in smaller numbers (SA SEI Tallinn, 2012). The volume of recreational fishing compared to trawl fishing is marginal.

The main raw material of the Estonian fish processing companies are local fish species, the Baltic herring and the sprat, and for the filleting companies fresh water fish, the perch and the pike-perch. In 2011, 22% of Estonian total production (fishing and aquaculture) of fish and fish products remained in the country for consumption and 78% was exported (Eesti kalanduse strateegia 2014-2020, 2013).

A very important pressure in the fisheries sector is the selective extraction of species as well as organic matter inputs into the sea. A weakness of the fisheries sector (e.g. in the Gulf of Riga) is high intensity of fishing, which main cause is a large number of fishing gear. It is necessary to find a balance between fishing opportunities and the existing resources. Illegal fishing is also a problem on the Baltic Sea (Eesti kalanduse strateegia 2014–2020, 2013).

Aquaculture
In Estonia, offshore aquaculture practice is represented by some individual cases and experts are of an opinion that no appropriate competence in this field exists in Estonia. Although there are suitable sites for farms in the sea, they are few.

As there exist regions that are potentially suitable for offshore aquaculture, the offshore aquaculture in Estonian conditions should be studied and tested. To develop offshore aquaculture, the following is necessary (Jaanuska, 2015):

- The nutrients loop principle must be introduced into the Environmental Code. If feed is made from fish caught from the Baltic Sea, a permit for special use of water is awarded using a simplified procedure for the farming of fish of same amount containing the same amount of phosphorous that is bound in the feed.
- Vaccination equipment that is necessary to continue farming the salmonids in the sea has to be obtained.
- The problem of building rights has to be resolved that makes the process of starting using seawater areas very long.

Marine transport and ports (including maritime rescue)
Because of its geographic location, Estonia lies along an important international east-west trading route. According to HELCOM (2014) data, the main traffic happens in the norther part of the Baltic Sea in the Gulf of Finland.

Ports service international and internal carriage of passengers and cargo. Almost all transit of goods is conducted through ports. Besides large ports, small and fishing harbours play an important role not only on the local level but also internationally.

Search and rescue operations of people in distress at sea under Estonia`s responsibility and on Lake Peipsi, Lake Lämmi and Lake Pihkva are carried out by the Police and Border Guard Board. Maritime rescue is ensured with the readiness of small units at coastal border points. Voluntary marine rescue is well-developed.

As the Baltic Sea is an ecologically easily threatened marine area and a pollution-sensitive ecosystem and also a region with intensive traffic, efforts must be continued to improve the safety and security of navigation in the region. It is also important to continue increasing maritime rescue capacity (including, for example, updating of relevant equipment). From the socio-economic point of view, it is important to address the issue of harbours (including small and fishing harbours) and development of their infrastructure.

Natural recourses (mineral resources, wind) and using thereof

The largest deposits of **mineral resources** in the marine area that have been registered are located west and northwest of Hiiumaa where are Hiiumadal and Kõpu sand deposits. In addition, sea mud is excavated in Estonia. The Kassari Bay is a habitat for a **red algae species** *Furcellaria lumbricalis* from which furcellaran is produced that can be used as a stabilising, thickening and gelatinizing substance in food, agriculture, cosmetics and pharmacy industries.

Currently, there are no wind generators and windfarms in the marine areas. Estonia`s western coastal sea is primarily suitable for the establishment of **offshore windfarms** (National Spatial Planning *"Estonia 2030+"*; Figure 2.24). Estonia`s northern coastal sea, Lake Peipsi and Lake Võrtsjärv are not suitable for the establishment of windfarms due to natural conditions and national defence purposes.

The potential of wave energy exists in the entire Baltic Sea. A central problem in using wave energy is the seasonal icing of the Baltic Sea. There are several ongoing projects that study the possibility to produce electricity for local use from wave energy in the icing sea and it can be said that this energy production method will be used in future, if in a limited amount.

There are several sea-based natural resources that are used or can be potentially used. It is important to find a balance between using natural resources and related potential environmental impacts.

Marine cultural heritage and traditional coastal lifestyle

Estonia has a rich sea-related cultural heritage, be it cultural valuables (wrecks) in the sea or the traditional coastal lifestyle. The coastal living environment is characterised by a beautiful natural environment, traditional coastal villages with interesting history and cultural heritage with potential for the development of tourism services and other small businesses and creating a high-quality living environment (Eesti kalanduse strateegia 2014–2020, 2013).

Maritime and coastal lifestyle heritage should be kept alive and made visible to people and accessible to all interested. Although these activities are mainly focused on the coastal areas, it must be also taken into account that maritime image must be improved among inland habitants by making known the opportunities to access the sea and coastal tourism possibilities.

Maritime education and research and development activity

Maritime education

As maritime subject is an interdisciplinary field, maritime education is provided by various educational institutions. Currently, there is a serious deficiency of ship`s officers in the EU and of the rating of EU citizens. On the one hand, the reason is increased international carriage of cargo; on the other hand, decreased interest in the seaman profession in the EU Member States. In Estonia, there is an excess of qualified seamen, because the national shipping industry has been in decline from the beginning of the 1990s. This has created a situation where we export our labour force to other EU Member States (Eesti merenduspoliitika 2012–2020, 2011).

Marine monitoring and development activity
Within the Estonian national environmental monitoring programme, marine monitoring is conducted that includes monitoring and distant monitoring of the coastal sea, high seas and sea coasts. In addition to sea monitoring, within the framework of the subprogrammes of nature diversity and landscape monitoring of the national environmental monitoring programme, the marine biota is monitored. The sea is also studied with one-time projects.

Marine monitoring needs joint coordinated activities, because the tasks are currently divided between five ministries.

Because the marine environment and maritime industry are important, it is necessary to continue providing quality marine education and facilitate scientific research.

Air quality
Exhausts from marine transport deteriorate air quality and bring into the environment undesirable nutrients. Pollution from marine transport is regulated by Annex VI of the Convention (Regulations for the Prevention of Air Pollution from Ships) MARPOL 73/78 of the International Marine Organisation (IMO).

As a result of international call to implement additional measures in order to reduce the emissions caused by marine transport, gradual reduction of the content of sulphur in fuels used on all seas to 0.5% from 2020 and in the SECAs to 0.1% from January 2015 was imposed. Provisions which purpose is to ensure compliance with the requirements are technologically neutral and the requirements may be fulfilled by reduction of emissions with alternative methods, such as exhaust gas cleaning systems, or using alternative clean fuels, such as liquefied gas (LNG) (Euroopa Komisjon, 2011).

Exhaust gas emissions generated by marine transport are significant because they deteriorate air quality and put undesirable nutrients into the environment. Therefore, it is important to deal with the reduction of air pollution.

Vessel traffic noise in air environment
Because ships that sail along waterways are far away, the level of noise caused by these ships that reaches the coast may be considered insignificant compared to the noise that reaches the water environment and affects the water biota. Outdoor noise caused by vessel traffic will be significant for the people that live near ports. In Estonia, according to the Health Board, there have been complaints by residents about noise from the territory of ports.

Outdoor noise generated by ship traffic is important in terms of human wellbeing and health primarily for the people that live in port regions. Consequently, it is especially important to pay attention to the noise issue when ports are being developed**.**

8.2 METHOD AND SCOPE OF SEA

Two main methods are used when preparing an SEA: compliance analysis and external impacts analysis. **Compliance analysis** is an assessment of the measures of the programme of measures to determine whether they are in agreement with the objectives set by other relevant strategic documents. **External impacts analysis** is an approach during which the planned activities are compared against a spectrum of external impacts. During the external effects analysis, it is analysed which areas of the natural, economic and social environment and to what extent are influenced by the measures of the programme of measures and, if necessary, suggestions are made for improving the measures of the programme of measures in terms of environmental aspects. In addition, if necessary, alternative or additional measures will be suggested to mitigate negative impacts and proposals will be made to amplify positive impacts. The assessments given during the SEA process are generally short-term and long-term.

During the external impacts analysis, the impacts are primarily assessed qualitatively (descriptively) in various areas of the natural and socio-economic environments. Based on the SEA programme (Annex 1), the presumed impact associated with the implementation of the programme of measures will be assessed in the following sections:

1. On the natural environment (including water environment, atmosphere, seafloor and coasts):
    - Impact on the marine biota and habitats (including impact on the protected nature objects and protection objectives of Natura 2000 areas and the integrity of the areas);
    - Impact on seawater quality and physical indicators of the marine environment (including underwater noise);
    - Impact on air quality and climate changes;
    - Impact on the sustainable use of natural resources and resources.

2. On the socio-economic environment:
    - Impact on human wellbeing and health (including outdoor noise);
    - Impact on maritime business environment (including fisheries, aquaculture, tourism etc.);
    - Impact on the marine transport and ports (including navigation safety and security);
    - Impact on the marine cultural heritage.

As the SEA is prepared under the principle of the level of precision of strategic development documents, impacts will be assessed on a more general level than in case of a detailed plan or activity permit, although no additional studies will be conducted during the SEA process. When giving assessments, the existing statistics, monitoring and research data are used.

The scope of the impacted area addressed during the SEA process is different by the respective areas. Generally, the area of impact stretches from the coast to the border of the Estonian economic zone, except for cross-border impact.

8.3 IMPACT ASSESSMENT

Compliance analysis (interlinkage of the programme of measures with other strategic documents) conducted during the SEA process identified that the measures of the programme of measures are not in conflict with the objectives specified in regional and European Union documents. No conflict was found with the objectives set down in the Estonian national documents.

Results of the **impacts analysis** have been presented by areas.

Impact on marine biota and habitats (including impact on protected natural objects)

Most new measures have a direct or indirect positive impact on the marine habitats, benthos and protected nature objects, but there are also measures which impact is difficult to assess because of insufficient information. Measures which extent of positive impact is currently difficult to asses are *"Establishing a marine protective areas network in Estonia`s economic zone*", *"Promotion of realisation of low-value fish", "Imposing restrictions on ship traffic in case of wave exposure impact", "Establishing an impulsive sound register*".

Impact on the quality and physical indicators of seawater

The new measures can be classified by the impact on seawater quality and the physical indicators of the marine environment as having a direct positive impact and an indirect impact.

Direct positive impacts (measures 1–3, 9–13, 17–21)

Measures *"Establishing a marine protection areas network in Estonia`s economic zone"* and "*Adoption* and *implementation of the ringed seal protection plan"* mean establishment of protected areas and they have a direct positive (preventive) impact. The most important positive impact is prevention of pressures related to developing certain marine areas (future protected areas). However, the neighbouring areas of the future protected areas may experience a stronger impact of anthropogenic pressures. However, the overall impact of protected areas on the marine environment is positive.

The measure *"Developing regional aquaculture plans to control a possible environmental pressure"* has a direct positive preventive impact. The measure alleviates, in a preventive manner, environmental impacts related to aquaculture, primarily impacts caused by inputs of substances (including nutrients) into the sea. It must be noted that due to eutrophication of the Baltic Sea, preference should be given to the development of nutrient-neutral practices or aquaculture that reduces nutrient content of the marine environment (nutrient-negative), then taking nutrients out of the marine environment may have a positive impact. The extent of the impact will be clear during implementation.

Measures 9–11 *"Promotion of use of liquefied natural gas (LNG) as ship fuel", "Reduction of disposal of untreated wastewater into the sea, including ensuring reception of wastewater from cruise ships in ports" and "Additional nutrient, hazardous substance and litter inflow reductions from stormwater directly to the sea – the construction of stormwater sewerage and treatment systems"* have a direct positive effect on eutrophication and concentrations of hazardous substances.

It is likely that the implementation of measure 12 *"Imposing restrictions on ship traffic in case of wave exposure impact"* will have a direct positive impact. The objective of the measure is to control exposure to waves caused by ships. Currently there is no information that ship waves pose a problem for the natural environment (coastal processes) in the Estonian marine area as a whole. There is a certain impact in the Tallinn Bay where other human activities (artificial coasts – ports, Pirita road etc.) have already significantly influenced and will influence the coastal processes. Therefore, the expert group does not see, solely from the point of view of the natural environment, that the measure is necessary. More important is the positive effect of the measure on the navigational safety of recreational craft.

The measures *"Improving the efficiency of marine pollution prevention capacity to respond to environmental emergencies at sea"* and *"Control of environmental risks that accompany bunkering operations at sea"* have a direct positive impact on the reduction of the content of hazardous substances in the sea by improving the pollution control capacity and reducing pollution risks.

The measures *"Preparing an action plan to improve the control over fishing gear and clean the sea of abandoned fishing gear, "Improving the marking system of fishing gear for better control and prevention of abandoning fishing gear", "Prevention of the marine littering problem and organisation of awareness building environmental educational events* and *cleaning sprees" and "Reducing the use of plastic bags, supporting relevant publicity and educational activities"* have a direct positive impact on the reduction of marine litter.

During the activities of the measure "*Establishing an impulsive sound register"*, a database is created that will allow presumably determine the importance of noise as a pressure on the environment.

Measures (4–8) with indirect impact
Measures *"Awareness building about non-indigenous species to control their invasion"* and *"Ratification of the international Ballast Water Management Convention (BWMC), facilitation of its implementation by participation in the regional information system and its implementation"*, which objective is to address the problem of non-indigenous species in the Estonian coastal sea, have an indirect impact. Improving the awareness about non-indigenous species hopefully improves the general attitude of population towards the marine environment. Application of the Ballast Water Management Convention does not probably play an important role in changing the physical indicators and quality of seawater besides its local impact.

Measures 6–8 influence positively fish populations. The impact is carried through the food chain into the circulation of substances, but it is presumably insignificant against other variability.

<u>Impact of measures in the contexts of the GES effort</u>
The new measures have a positive impact on all GES descriptors. There is a disproportionately high number (six) of marine litter related measures that could be combined. It should be possible to combine activities that are designed to improve people`s awareness (measures 4 and 17). For the fifth descriptor (*Human-induced eutrophication is minimised, especially adverse effects thereof, such as losses in biodiversity, ecosystem degradation, harmful algae blooms and oxygen deficiency in bottom waters*), the existing monitoring should be broadened to measure a positive effect. The same goes to the seventh descriptor (*Permanent alteration of hydrographical conditions does not adversely affect marine ecosystems*).

A certain negative impact may occur on the neighbouring areas of the new protected areas, which is the only theoretical cross-border impact of the natural environment. The overall impact on the Baltic Sea environment of protected areas is positive. The measures have a positive impact on the components of the ecosystem that influences the interactions of these components with varying degree. As the measures in combination reduce human influence in the marine environment, there is no reason to think that influencing the components with varying degree would cause a significantly negative environmental effect.

The suggestions worked out during the SEA for supplementing the programme of measures have been presented in section 8.4.

<u>Impact on air quality (including outdoor noise) and climate change</u>

Air pollution caused by marine transport significantly influences air quality and the climate at large. Pile-driving, explosions etc. cause underwater and outdoor noise. Consequently, it is important to continue activities that help reduce air pollution and noise due to maritime activities.

The area-specific analysis of the measures set out in the Marine Strategy`s programme of measures (see Table 5.1, chapter 5.1) showed that most measures have a direct or indirect positive impact on the improvement of air quality. The measure that has the main positive impact is related to the use of cleaner ship fuel, i.e. facilitating introduction of LNG.

The measure *"Establishing an impulsive sounds register"* of the programme of measures is related to identifying underwater noise and therefore is not directly related to the noise propagated outdoors. However, in many cases, an activity that causes underwater noise causes also noise that travels outdoors (e.g. pile-driving during the construction of quays etc.) that has an effect on the marine and coastal biota (e.g. birds) as well as people that live on the coast. Therefore, it is reasonable to consider during establishing an underwater noise register also enter into the register data about outdoor noise caused by the same sources. This would help to gather comprehensive (underwater and outdoor noise) information on the noise sources related to the marine environment.

The proposals worked out during the SEA for supplementing the programme of measures have been presented in section 8.4.

<u>Impact on sustainable use of natural resources and resources</u>

Implementation of the measures established in the programme of measures will mainly have a positive impact on the sustainable use of natural resources and resources. Upon implementation of the measures, the status of the marine environment will improve and the risk of pollution that could damage commercial fish and algae resources will decrease. A certain negative impact may be caused by the establishment and implementation of the protection plan for the ringed seal that places restrictions on the extraction of earth resources, establishment of wind turbines or development of aquaculture.

Using liquefied natural gas (LNG) as ship fuel that has a greater energy content than diesel fuel will reduce fuel costs, which has a positive impact on the resource use. Smaller fuel consumption also means smaller volumes of exhausts released into the air. A negative impact is the need to reconstruct the existing ships or build new ships that can use LNG as ship fuel, which also means using natural resources.

Establishing the impulsive sound register helps increase awareness of underwater noise that may cause imposition of restrictions on the excavation and the establishment of wind turbines in the region where there are deposits or where offshore wind parks are planned. However, establishing the register may dissolve doubts about the impact of underwater noise on the biota.

In summary, the author of this report does not see any need to highlight any new potential topics that have not been discussed in the programme of measures.

Impact on the well-being and health of humans (including outdoor noise)

The area-specific analysis of the measures included in the Marine Strategy`s programme of measures (see Table 5.1, section 5.1) showed that most measures have a positive impact on the well-being and health of people. The impact is mainly related to the fact that as the result of implementation of the measures seawater quality and air quality will improve and generation of marine litter will be reduced. The effect is on the lives of people that live on the coast as well as tourists (as regards air quality, also crew members) that are involved in sea-related activities every day or are involved with the sea for recreational purposes. The measures that may cause imposition of restriction on the movement of waterborne vessels or limit speed have a certain negative impact primarily on the well-being of marine tourists. However, it can be presumed that the restrictions are local and do not cause a significant negative impact.

The measure *"Establishing an impulsive sounds register"* of the programme of measures is related to identifying underwater noise and therefore is not directly related to propagation of outdoor noise. However, in many cases, an activity that causes underwater noise causes also noise that travels outdoors (e.g. pile-driving during the construction of berths etc.) that has an effect on the marine and coastal biota (e.g. birds) as well as people that live on the coast. Therefore, it is reasonable to consider during establishing the underwater noise register also entering into the register data on outdoor noise caused by the same sources. This would help to gather comprehensive (underwater and outdoor noise) information on the noise sources related to the marine environment.

The proposals worked out during the SEA to supplement the programme of measures have been presented in section 8.4.

Impact on the marine business environment (including fisheries, aquaculture, tourism etc.)

Upon implementation of the measures of the programme of measures, a positive impact on the development of aquaculture is expected. The measures of the programme of measures addressing fisheries (measures 6–8, Table 5.1, section 5.1) are designed to improve the reproduction capacity of fish populations and are primarily related to imposing restrictions on fishing. The mentioned measures have a short-term negative impact on the companies involved in the fisheries sector (including coastal fishermen). However, it is a short-term impact and what is important is that fishing is not entirely banned. If the measures are not implemented, important commercial fish stocks will continue to decline that would have also a negative impact on the fisheries sector in long term. If the measures are implemented, a positive long-term impact can be expected, because it is presumed that the state of fish stocks will improve, allowing to continue with fishing as a traditional business. The short-term negative impact may be alleviated to a certain extent by the measure *"Promotion of realisation of low-value fish"*.

Upon implementation of the measures of the programme of measures, there will be a positive impact on business in long term (because of the improved marine environment status) or a significant impact is not foreseen. To implement certain measures (measures 5, 9, 10, 14, 15, 20), companies involved in maritime industry incur some additional expenses (a negative impact). It is important to development a national support system and implement it.

Consequently, the author of this report does not see any need to highlight any new potential topics that have not been discussed in the programme of measures.

Impact on marine transport and ports (including navigational safety and security and marine rescue)

A long-term positive impact from the implementation of the measures of the programme of measures is achieved that is mainly expressed in a cleaner marine environment (e.g. reduction of litter in port basins), a better pollution control capacity (e.g. reduction of possibilities of pollution reaching port basins) and enabling development of port infrastructure (e.g. in relation to aquaculture). However, implementation of several measures requires ship and port owners to make additional investments. Therefore, it is important to develop a national support system and implement it. Of the planned measures, the largest expenditures are expected to be incurred in relation to the introduction of LNG as ship fuel.

Consequently, the author of this report does not see any need to highlight any new potential topics that have not been discussed in the programme of measures.

Impact on marine cultural heritage

The measures of the programme of measures that are designed to improve seawater quality and cleanliness and maintenance of beaches and the coast have an overall indirect positive impact on marine cultural heritage. Direct impacts are related to imposing of fishing restrictions that have an impact on the coastal fishermen and preservation of the coastal lifestyle as an important aspect of marine cultural heritage.

Imposing fishing restrictions may have a short-term negative impact on the coastal fishermen and the preservation of coastal lifestyle as an important part of the marine cultural heritage. At the same time, the fact that the main objective of the measure is to improve fish populations' reproduction capacity is important. If additional restrictions are not imposed, it may lead to a situation where traditional fishing activities disappear entirely because of the poor state of fish stocks. In a long-term perspective, imposing restrictions on fishing has a positive impact, because the status of fish stocks is expected to improve, allowing the fishermen to continue with fishing. The measure *"Promotion of realisation of low-value fish"* included in the programme of measures can alleviated the short-term negative impact to a certain extent.

Consequently, the author of this report does not see any need to highlight any new potential topics that have not been discussed in the programme of measures.

Cumulative impacts and cross-border influence

The measures have an overall positive environmental impact on the **natural environment**. Most of the measures have a positive cumulative impact. Negative impacts that cumulate in time may occur on the neighbouring areas of the future protected areas. It is necessary to make an analysis of these impacts after more details are available about the future protected areas. For example, creating more favourable conditions for the seals may cause a bigger pressure on the fish species that they feed on. As the measures in combination reduce the anthropogenic impact in the marine environment, there is no reason to think that influencing the components with a varying degree would cause a significant negative cumulative environmental impact.

Most of the measures included in the programme of measures have a positive impact on the well-being and health of humans in the **socio-economic environment**. The impact is mainly related to the fact that as a result of implementation of the measures seawater and air quality will improve, generation of marine litter will be reduced and the pollution control capacity will increase. People that live on the coast as well as tourists (as regards air quality, also crew members) whose lives are linked to the sea or that use the sea for recreational purposes. The cumulative negative impacts on the socio-economic environment are related to the additional expenses that port and ship owners have to make upon implementation of several measures (e.g. with introduction of LNG as ship fuel). Imposition of various catch restrictions and optimising catching capacity have negative impacts on commercial fishermen.

Cross-border impact
The Marine Strategy Framework Directive specifies that the Member States shall identify the measures which need to be taken in order to achieve good environmental status of the Baltic Sea by 2020. Although every Member State prepares its programme of measures individually, the objective of developing the measures is common for all Member States and therefore the improved marine environment status of one Member State will have a positive impact (at least in long term) on the marine environment of other Member States` marine areas.
An activity that theoretically has a cross-border negative environmental impact may occur when protected areas are established, if this causes major changes in the routing system in the region. This may then lead to a situation where routing is directed past the protected area and if an accident happens on the new route with a leakage of fuel or oil then the pollution from the new route may be carried with currents over the border of Estonia`s economic zone. It must be stressed that this is a theoretical cross-border impact that should be considered when the protected areas are established if it requires shifting routes outside the protected area. The overall impact of the protected areas on the Baltic Sea environment is positive.

8.4 PROPOSALS

Below are presented the proposals of the author of the SEA to supplement the programme of measures in terms of environmental aspects:

- **We recommend to establish an operative radioactive detection system in the Estonian marine areas.** As the first step, constant monitoring of radioactivity in the Gulf of Finland could be introduced. The detector(s) may be integrated into the first autonomic offshore measuring station of the Baltic Sea near the Keri Island.
- **We recommend to establish a common database on the excavation and dredging and dumping operations on the sea**. The database would give a comprehensive overview of the works being done that modify the coast and seafloor in the Estonian marine areas and the database could be used in spatial planning, in the environmental impact assessment process in property development and during monitoring. The database should include information about the presumed dredging (dumping) volume (in the phase of applying for a permit of special use of water), the actual dredging volume (will be clear after the works have been performed), integration of sediments and content of hazardous substances in sediments. If the works have been monitored, the database must include references to the monitoring reports. **Based on the gathered data, it is possible to prepare a pressure indicator of excavation and dredging and dumping operations** for the Estonian marine areas.
- **Measure 12 has a positive impact on navigational safety and a certain positive side effect on the natural environment, but it should be worded in accordance with its main objective – navigational safety.** If the reworded measure does not fit into the Marine Strategy`s programme of measures any more, implementation of the activity in Estonia should be considered with the help of other mechanisms, for example, by the implementation of the Development Plan of the Marine Policy.

- **We recommend** to continue with the tradition that has developed during the environmental impact assessment process: **not to conduct dumping operations in shallows areas in coastal regions.** For that purpose, the distribution of official dumping areas in the Estonian coastal sea must be reviewed and, if necessary, changed. An exception is the areas with active sediment transport where it may be reasonable to release dredged material on the coast or into a trench near coast to reduce this deficiency (this suggestion can be made by the environmental impact assessment expert group). **Estonia has to conduct an inventory of dumping sites based on the London convention.**
- **We recommend to include for additional analysis a study on the environmental protection feasibility and economic profitability of making openings into Väike väin dyke to the additional studies of the programme of measures.**
- **We recommend to gather into the impulsive sound register also data on the same source outdoor noise.**

The problems of marine environment monitoring and GES indicators are not directly the topic of the programme of measures. However, it is important to resolve the issue of indicators before implementation of the measures. Otherwise, it is not possible to determine the efficiency of the measures or make decisions on the following steps. Based on the above, the expert group has the following observations and suggestions on GES indicators and the monitoring programme:

- **To review two indicators related to non-indigenous species and word them in accordance with the target set regarding the non-indigenous species, i.e. new non-indigenous species are not added through primary invasion;**
- **To add constant automatic measurements of currents, waves, temperature, salinity, chl *a* fluorescence, dissolved oxygen and nutrients to the national marine monitoring programme.** Measuring of some of the listed parameters have been offered prior (TTÜ Meresüsteemide Instituut, 2014);
- **To develop usable indicators for the descriptor "Permanent alteration of hydrographical conditions does not adversely affect marine ecosystems";**
- **To add a parameter to the list of indicators for the descriptor "Concentrations of contaminants are at levels not giving rise to pollution effects" that would directly describe the frequency and volume of oil pollution detected on the sea. For example, PF (Pollution per Flight) index that shows the number of spills detected per flight hour can be used;**
- **To develop usable indicators for the descriptor "Properties and quantities of marine litter do not cause harm to the coastal and marine environment". We recommend to consider using the indicators (at least partly) offered in the programme of measures as GES indicators. The chosen indicators should be added to the national marine monitoring programme.**

8.5 DESCRIPTION OF MONITORING REQUIREMENTS AND FOLLOW-UP

Environmental monitoring is a constant observation of environmental status and factors influencing it that includes environmental observations and analyses and processing of monitoring data.

In order to assess the actual environmental impact of the measures that are designed to achieve the objectives of the programme of measures, it is necessary to conduct assessment/analysis of the quality of the environmental components periodically. The monitoring and follow-up of the programme of measures must give information on how any implemented measure has influenced various environmental components. At the same time, implementation of the planned measures influences also socio-economic environment. Hence, it is not only necessary to gather data on the natural environment and environmental pollution, but also on the social and economic environment. The authority that gathers and analyses monitoring data is the authority that initiates the preparing of the programme of measures and approves it, i.e. the Ministry of the Environment in cooperation with other competent authorities.

The author of the SEA recommends to monitor the parameters of the natural as well as socio-economic environment. The suggested monitoring measures have been presented in section 6 of the SEA report.

MAIN REFERENCES

- Admiral Danish Fleet HQ, National Operations, Maritime Environment, 2011. Sub-regional risk of spill of oil and hazardous substances in the Baltic Sea (BRISK). Risk Model Result Report.
- Andrejev O., Myrberg K., Alenius P. and Lundberg P.A., 2004. Mean circulation and water exchange in the Gulf of Finland - a study based on three-dimensional modeling. Boreal. Env. Res. 9: 1-16.
- BACC II autor team, 2015. Assessment of Climate Change for the Baltic Sea Basin, 477 lk, Springer.
- Balti Keskkonnafoorum, 2011. Väärtuslikud avameremadalikud Eesti vetes.
- Bergman A., 2007. Pathological changes in seals in Swedish waters: The relation to environmental pollution. Tendencies during a 25-year period. Thesis No.2007: 131, Swedish University of Agricultural Sciences, ISBN 978-91-85913-30-5.
- Bergström, L., Sundqvist, F. & Bergström, U., 2013. Effects of an offshore wind farm on temporal and spatial patterns in the demersal fish community. Marine Ecology Progress Series, vol. 485, 199–210.
- Bredhult C., Bäcklin B., Bignert A. & Olovsson M., 2008. Study of the relation between the incidence of uterine leiomyomas and the concentrations of PCB and DDT in Baltic gray seals. Reproductive Toxicology (2):247-225.
- Bruijs MCM & Durif CMF, 2009. Silver eel migration and behaviour. Spawning Migration of the European Eel: 65-95.
- Dekker W., 2003. Status of the European eel stock and fisheries. Eel Biology: 237-254.
- Durinck, J., Skov, H., Jensen, F.P. & S. Pihl., 1994. *Important Marine Areas for Wintering Birds in the Baltic Sea*. EU DG XI research contract no. 2242/90-09-01. Ornis Consult report, 110.
- EELIS (Eesti Looduse Infosüsteem – Keskkonnaregister): Keskkonnaagentuur (september 2015).
- EELIS: Infoleht (15.09.2015). Natura 2000 loodusalad ja linnualad.
- Eelsalu, M., 2013. Laineenergia potentsiaal Eesti rannikumeres.
- Eesti elektrimajanduse arengukava aastani 2018, 2008.
- Eesti kalanduse strateegia 2014–2020, 2013.
- Eesti Keskkonnastrateegia aastani 2030, 2007.
- Eesti Keskkonnauuringute Keskus, 2012. Õhukvaliteedi andmete kogumine ja aruandlus. 2012 a. aruanne.
- Eesti Looduse Fond, 2007. Merereostustõrje käsiraamat.
- Eesti maaelu arengukava 2014–2020, 2014.
- Eesti Mereinstituut, (15.09.15). Natura 2000 rakendamine Eesti merealadel: alade valik ja kaitsemeetmed - ESTMAR, 2007-2011. (http://www.sea.ee/estmar/).
- Eesti riiklik turismiarengukava 2014–2020, 2013.
- Eesti säästva arengu riiklik strateegia aastani „Säästev Eesti 21“, 2005.
- Eesti taastuvenergia tegevuskavas aastani 2020, 2010.
- Eesti vesiviljeluse sektori arengustrateegia 2014–2020.
- Ellermaa M., Pettay T. & Könönen J., 2010: Sügisränne Põõsaspeal 2009. aastal. *Hirundo* 23:21-46.

- Eschbaum, R., 2009. Kalastiku uuring. Sõitjate ja veoste üle Suure väina veo perspektiivse korraldamise kava koostamine ja keskkonnamõjude strateegiline hindamine, Majandus- ja kommunikatsiooniministeerium, Maanteamet.
- Eschbaum, R., A. Albert, H. Špilev, K. Jürgens, M. Vetemaa, Ü. Talvik, A. Verliin, and T. Saat., 2011. "Rannikumere kalad." Rahvusliku kalanduse andmekogumisprogrammi täitmine. III vahearuanne, edited by T. Saat, pp. 1-193. Tallinn: TÜ Eesti Mereinstituut.
- Euroopa Komisjon, 2011. Komisjoni teatis Euroopa Parlamendile, Nõukogule, Euroopa Majandus- ja sotsiaalkomiteele ning Regioonide Komiteele, milles käsitletakse direktiivi 1999/32/EÜ rakendamise läbivaatamist seoses teatavate vedelkütuste väävlisisaldusega ja meretranspordist tuleneva saasteainete heite täiendavat vähendamist. Brüssel, 15.7.2011; KOM(2011) 441 lõplik.
- Euroopa Liidu bioloogilise mitmekesisuse strateegia aastani 2020, 2010.
- Euroopa Liidu Läänemere piirkonna strateegia.
- European Environment Agency (EEA), 2013. The impact of international shipping on European air quality and climate forcing. EEA Technical Report, No 4/2013.
- Final report of Baltic marine litter project MARLIN - litter monitoring and raising awareness. 2011-2013, http://www.projectmarlin.eu, 13.08.2015.
- Fleming, V. & Kaitala, S., 2006. Phytoplankton spring bloom intensity index for the Baltic Sea estimated for the years 1992 to 2004. *Hydrobiologia* 554, 57–65.
- Fleming-Lehtinen V., Laamanen, M., Kuosa, H., Haahti, H. & Olsonen, R., 2008. Long-term development of inorganic nutrients and chlorophyll a in the open northern Baltic Sea. *Ambio* 37, 86-92.
- GASUM jt., 2015. Balticconnector. Soome ja Eesti vaheline maagaasitorustik. Keskkonnamõju hindamise aruanne.
- Graham, A.L. and Cooke, S.J., 2008. The effects of noise disturbance from various recreational boating activities common to inland waters on the cardiac physiology of a freshwater fish, the largemouth bass (Micropterus salmoides). Aquatic Conservation Marine and Freshwater Ecosystems 18, 1315–1324.
- Handegard, N.O., Michalsen K. & Tjøstheim, D., 2003. Avoidance behavior in cod, *Gadus morhua*, to a bottom trawling vessel. Aquatic Living Resources 16, 265–270.
- Harding K.C. & Härkönen T.J., 1999. Development in the Baltic grey seal (Halichoerus grypus) and Ringed seal (Phoca hispida) populations during the 20th century. AMBIO 28, No.7: 619-627.
- Harkonen T., Jüssi M., Jüssi I., Verevkin M., Dmitrieva L., Helle E., Sagitov R. & Harding K. C., 2008. Seasonal Activity Budget of Adult Baltic Ringed Seals. PLoS ONE 3(4). DOI: 10.1371/journal.pone.0002006.
- Harrastuskalapüügi arengukava aastateks 2010–2013 (perspektiiviga kuni 2018).
- HELCOM 2014b. Annual report on illegal discharges observed during arieal surveillance 2013, 13 pp.
- HELCOM, 2006. Development of tools for assessment of eutrophication in the Baltic Sea. Baltic Sea Environment Proceedings No. 104, 64 pp.
- HELCOM, 2009. Biodiversity in the Baltic Sea – An integrated thematic assessment on biodiversity and nature conservation in the Baltic Sea. Balt. Sea Environ. Proc.116B.
- HELCOM, 2009b. Eutrophication in the Baltic Sea. An integrated thematic assessment of the effects of nutrient enrichment in the Baltic Sea region. Baltic Sea Environment Proc. 115B, 148 p.

- HELCOM, 2010. Maritime Activities in the Baltic Sea – An integrated thematic assessment on maritime activities and response to pollution at sea in the Baltic Sea Region. Balt. Sea Environ. Proc., 123.
- HELCOM, 2010b. Hazardous Substances in the Baltic Sea- An Integrated Thematic Assessment of Hazardous Substances in the Baltic Sea. Balt. Sea Environ. Proc. 120B, 116p.
- HELCOM, 2012. Checklist of Baltic Sea Macro-species. Baltic Sea Environment Proceedings No. 130.
- HELCOM, 2014. Annual report on shipping accidents in the Baltic Sea in 2013.
- HELCOM. 2004. The Fourth Baltic Sea Pollution Load Compilation (PLC-4). Baltic Sea Environment Proceedings, 93, 1-188.
- HELCOMi Läänemere tegevuskava aastani 2021, 2007.
- Hendrikson & Ko OÜ, 2011. Neugrundi meretuulepargi keskkonnamõju hindamine. Aruanne Töö nr: 864/06. Tartu. 449 pp.
- Herküll, K. & Kotta, J., 2012. Assessment of the ecological impact of an oil spill on shallow brackish-water benthic communities: a case study in the northeastern Baltic Sea. Estonian Journal of Ecology 61 (3): 173-189.
- Hiiu maakonnaga piirnevate merealade maakonnaplaneering (kehtestamata);
- http://geoportaal.maaamet.ee/, Maavarude koondbilansid, 31.08.2015.
- http://loodus.keskkonnainfo.ee/eelis/default.aspx?id=1678265564&state=3;-951956260;est;eelisand.
- http://www.itopf.com/knowledge-resources/documents-guides/environmental-effects/
- Hänninen, S. & J. Sassi (2009) Estimated nutrient load from waste waters originating from ships in the Baltic Sea area – Updated 2009. Researched Report VTT-R-07396-08.
- ICES, 2011b. Report of the Working Group on Widely Distributed Stocks (WGWIDE), 23 - 29 August 2011, ICES Headquarters, Copenhagen, Denmark. ICES CM 2011/ACOM:15. 642 pp.
- ICES. 2011. Report of the ICES Advisory Committee, 2011. ICES Advice, 2011. Book 1.
- ITOPF (23.09.15). Environmental effect of oil spills.
- ITOPF, 2011. Effects of oil pollution on the marine environment. Technical information paper 13.
- Jaanus, A., Andersson, A., Hajdu, S., Huseby, S., Jurgensone, I., Olenina, I., Wasmund, N. & Toming, K., 2007. Shifts in the Baltic Sea summer phytoplankton communities in 1992-2006. HELCOM Indicator Fact Sheets 2007. Online 15.09.2015, http://helcom.fi/baltic-sea-trends/environment-fact-sheets/eutrophication/shifts-in-the-baltic-sea-summer-phytoplankton-communities-in-1992-2006.
- Jaanuska, H., 2015. Vesiviljeluse laiendamiseks sobivaimate alade kaardistamise, vajalike infrastruktuuride arendamise ja innovatsiooniliste tehnoloogiate elluviidavas.
- Johansson, L., Jalkanen, J.-P., Kalli, J. & Kukkonen, J., 2013. The evolution of shipping emissions and the costs of recent and forthcoming emission regulations in the northern European emission control area. Atmospheric Chemistry and Physics Discussions, 13, 16113–16150, 2013.
- Järvik, A., 2011. Loode-Eesti rannikumere madalikele tuuleparkide rajamise KMH. Töö nr. LPMI01655. Tallinn: TÜ Eesti Mereinstituut. 244 pp.

- Jüssi M., Härkönen T., Helle E., Jüssi I., 2008. Decreasing Ice Coverage Will Reduce the Breeding Success of Baltic Grey Seal (Halichoerus grypus) Females. AMBIO 37 (2), lk 80-85.
- Jüssi, I., 2010. Mereimetajad. Sõitjate ja veoste üle Suure väina veo perspektiivse korraldamise kava koostamine ja keskkonnamõjude strateegiline hindamine, Majandus- ja kommunikatsiooniministeerium, Maanteeamet.
- Kalli, J., Jalkanen, J-P., Johansson, L. & Repka, S., 2013. Atmospheric emissions of European SECA shipping: long-term projections. WMU Journal of Maritime Affairs (2013) 12:129–145.
- Keskkonnaamet, 2009. Küdema lahe hoiuala ja Laidu saare looduskaitseala kaitsekorralduskava 2011-2020. http://www.keskkonnaamet.ee/kkk/Kydema_lahe_HA_ja_Laidu_saare_LKA_KKK_2011_2020.pdf.
- Keskkonnaamet, 2011. Hiiumaa laidude maastikukaitseala kaitsekorralduskava 2011–2019. http://loodus.keskkonnainfo.ee/eelis/GetFile.aspx?fail=-1153133558.
- Keskkonnaamet, 2011b. Abruka looduskaitseala ja Abruka hoiuala kaitsekorralduskava aastateks 2011-2020. http://loodus.keskkonnainfo.ee/eelis/GetFile.aspx?fail=-381321612.
- Keskkonnaamet, 2012. Väinamere hoiuala mereosa, Kadakalaiu viigerhülge, Pujuderahu hallhülge ja Selgrahu hallhülge püsielupaikade (osa Väinamere linnu- ja loodusalast) kaitsekorralduskava 2013–2022 http://www.keskkonnaamet.ee/kkk/Vainamere_HA_mereosa_hylgePEPid_KKK_2013_2022.pdf.
- Keskkonnaamet, 2012b. Tagamõisa puisniidu ja Tagamõisa hoiuala kaitsekorralduskava aastateks 2012-2021 http://loodus.keskkonnainfo.ee/eelis/GetFile.aspx?fail=2043112556.
- Keskkonnaamet, 2013. Hädaolukordade riskianalüüs. Ulatuslik rannikureostus.
- Keskkonnaamet, 2015. Hallhüljes (*Helichoerus grypus*). 6.09.2015. URL: http://www.keskkonnaamet.ee/teenused/jahindus-4/hulgejaht/
- Keskkonnaministeerium, 2012. Üleujutusohuga seotud riskide esialgne hinnang.
- Keskkonnaministeeriumi koduleht, liigikaitse http://www.envir.ee/et/liigikaitse (19.09.15).
- Kesler M., Kangur M., Vetemaa M., 2011. Natural re-establishment of Atlantic salmon reproduction and the fish community in the previously heavily polluted River Purtse, Baltic Sea. Ecology of Freshwater Fish, 3: 472-477.
- Kotta, I., Kotta, J., 1997. Changes in zoobenthic communities in Estonian waters between the 1970's and 1990's. An example from the southern coast of Saaremaa and Muuga Bay. In: Proceedings of the 14th Baltic Marine Biologists Symposium. Ojaveer, E. (ed.). Estonian Academy Publishers, Tallinn, 70–79.
- Kotta, J., Jaanus, A., Kotta, I., 2008. Haapsalu and Matsalu Bay. Schiewer, U. (Toim.). Ecology of Baltic Coastal waters (245 - 258). Springer, Berlin.
- Kousa, A., Koskentalo, T. & Matilainen, L., 2013. SNOOP - Exposure and health effects estimation in Helsinki, Turku and Tallinn.
- Kowalczuk, P., Zabłocka, M., Sagan, S., Kuliński, K., 2010. Fluorescence measured in situ as a proxy of CDOM absorption and DOC concentration in the Baltic Sea. Oceanologia, 52, 431–471.
- Kujala, P., Hänninen, M., Arola, T. ja Ylitalo, J., 2013. Reliability Engineering and System Safety, 94(8), pg. 1349–1357.

- Laanemets, J., Väli, G., Zhurbas, V., Elken, J., Lips, I. and Lips, U., 2011. Simulation of mesoscale structures and nutrient transport during summer upwelling events in the Gulf of Finland in 2006. Boreal Env. Res., 16A, 15-26.
- Lagemaa, P., 2012. Operational Forecasting in Estonian Marine Waters., Tallinna Tehnikaülikool Meresüsteemide Instituut, Tallinn: TTU Press.
- Lahemaa rahvuspargi kaitsekorralduskava 2016-2025 tööversioon, mai 2015.
- Larsson K. & Tydén L., 2005. Effects of oil spills on wintering Long-tailed Ducks Clangula hyemalis at Hoburgs Bank in the central Baltic Sea between 1996/97 and 2003/04. Ornis Svecica, 15:161–171.
- Lehmann, A. Getzlaff, K., Harlass, J., 2011. Detailed assessment of climate variability in the Baltic Sea area for the period 1958 to 2009. Climare Research, 46 (2011), pp. 185–196.
- Liblik, T ja Lips, U., 2011. Characteristics and variability of the vertical thermohaline structure in the Gulf of Finland in summer. Boreal Env. Res., 16A, 73–83.
- Liblik, T., Laanemets, J., Raudsepp, U,. Elken, J., Suhhova, I., 2013. Estuarine circulation reversals and related rapid changes in winter near-bottom oxygen conditions in the Gulf of Finland, Baltic Sea. Ocean Science, 9, 917 - 930.
- Lilja, K., Norström, K., Remberger, M., Kaj, L., Egelrud, L., Junedahl, E., Brorström-Lunden, E., Ghebremeskel, M., Schlabach, M., 2009. Screening of Selected Hazardous Substances in the Eastern Baltic Marine Environment,*Report B 1874*, September 2009, 57 p.
- Lilover, M.-J.; Stips, A., 2008. The variability of parameters controlling the cyanobacteria bloom biomass in the Baltic Sea. Journal of Marine Systems, 74(SI), S108 - S115.
- Lips, I., Lips. U. and Liblik, T., 2009. Consequences of coastal upwelling events on physical and chemical patterns in the central Gulf of Finland (Baltic Sea). Continental Shelf Research, 29, 1836- 1847.
- Looduskaitse arengukava aastani 2020, 2012.
- Loos, R., Gawlik, B.M., Locoro, G., Rimaviciute, E., Contini, S., Bidoglio, G., 2008. EU Wide Monitoring Survey of Polar Persistent Pollutants in European River Waters. JRC Scientific and Technical Reports EUR 23568 EN, JRC 48459, Luxembourg: Office for Official Publications of the European Communities, European Communities, 2008, 51p.
- Lääne maakonnaplaneeringu tuuleenergeetika teemaplaneering, 2013.
- Lääne-Eesti, Ida-Eesti ja Koiva vesikonna veemajanduskavad 2015–2021.
- Maaeluministeerium, 2015. Varasemate aastate püügiandmed. 28.09.2015. http://www.agri.ee/et/varasemate-aastate-puugiandmed.
- Mackenzie, B. R. and Schiedek, D., 2007. Daily ocean monitoring since the 1860s shows record warming of northern European seas. Global Change Biology, 13: 1335–1347. doi: 10.1111/j.1365-2486.2007.01360.
- Majandus- ja Kommunikatsiooniministeerium, 2013. Merendussektori ülevaade 2012.
- Majandus- ja Kommunikatsiooniministeerium, 2014. 2013. a merenduspoliitika täidetud tegevused.
- Martin G., 2000. Phytobenthic communities of the Gulf of Riga and the Inner Sea of the West-Estonian Archipelago. Doktoritöö. Tartu University Press.
- Mustonen, M., 2013. Noise as an environmental challenge for ports;

- Myrberg, K., Andrejev, O., 2003. Main upwelling regions in the Baltic Sea – a statistical analysis based on three-dimensional modelling. Boreal Environment Research 8 (2), 97–112.
- Natura 2000 (17.09.15). Eestis esinevad loodusdirektiivi taime- ja loomaliigid. http://www.natura2000.envir.ee/files/doc/eestiliigid.pdf.
- Natura 2000. Linnu- ja loodushoiualade võrgustik. 15.09.15, 16.09.15. http://www.natura2000.envir.ee/.
- Nord Stream, 2009. Environment impact assessment report. Natural gas pipeline through the Baltic Sea. Environmental imact assessment in the exclusive economic zone of Finland. 1–966.
- Ojaveer H., Kotta J., Põllumäe A., Põllupüü M., Jaanus A. & Vetemaa M., 2011. Alien species in a brackish water temperate ecosystem: annual-scale dynamics in response to environmental variability. Environ. Res., 111, 933–942.
- Ojaveer, E. & Drevs, T., 2003. Flounder, Platichthys flesus trachurus (Duncker). Fishes of Estonia (362-370). Tallinn: Estonian Academy Publishers.
- Ojaveer, H. & Järv, L. 2003. Eelpout, *Zoarces viviparus* (L.). Ojaveer, E., Pihu, E., Saat, T. (Toim.). Fishes of Estonia (316 - 323). Tallinn: Estonian Academy Publishers.
- Ojaveer, H., Eek, L. & Kotta, J., 2011. Vee võõrliikide käsiraamat. Tallinn.
- Oregon Sierra Club, 2014. Summary of Recent Science: Climate Impacts of Natural Gas Production and LNG Export. Edition One, August 7, 2014 (http://www.westernlaw.org/sites/default/files/Summary%20of%20Recent%20Science-Climate%20Impacts%20of%20Natural%20Gas%20Production%20and%20LNG%20Export-Edition%20One%20FINAL-August%207%202014%5B1%5D.pdf).
- Orviku, K., 1993. Nüüdisrandla. Rmt.: Lutt, J. & Raukas, A. (toim.) Eesti Šelfi Geoloogia. Eesti Geoloogia Selts. Tallinn.
- OSPAR Commission, 2009. Overview of the impacts of anthropogenic underwater sound in the marine environment, OSPAR Convention for the Protection of the Marine Environment of the North-East Atlantic. Biodiversity and Ecosystem Series, 1–134.BIAS 2014.
- OÜ Alkranel, TTÜ Meresüsteemide Instituut, OÜ Artes Terrae., 2015. Hiiu maakonnaga piirneva mereala maakonnaplaneeringu keskkonnamõju strateegiline hindamine.
- Pihu E & Turovski A., 2001. Eesti mageveekalad. Tallinn. 2001.
- PwC AS, 2014. Logistikasektori mõjuulatus Eesti majanduses.
- Põllumäe, A. & Kotta, J., 2007. Factors describing the distribution of the zooplankton community in the Gulf of Finland in the context of inter¬actions between native and introduced predatory cladocerans. Oceanologia 49(2), 277–290.
- Põllumäe, A., Kotta, J. & Leisk, Ü., 2009. Scale-dependent effects of nutrient loads and climatic conditions on benthic and pelagic communities in the Gulf of Finland. Marine Ecology 30, (Suppl. 1), 20–32.
- Pärnu maakonnaga piirnevate merealade maakonnaplaneering (kehtestamata).
- Raid, T., Kaljuste, O., Špilev, H. and Lankov, A., 2011. Räim ja kilu. Rahvusliku kalanduse andmekogumisprogrammi täitmine. III vahearuanne, edited by T. Saat, pp. 1-65. Tallinn: TÜ Eesti Mereinstituut.
- Ramboll Eesti AS, 2007. Pt 3.3. Traffic Analysis of Shipping Routes. Technical Assistance for dredging and reconstruction of shipping routes in West-Estonian Archipelago.

- Ramboll Eesti AS, 2008. Tehniline abi laevateede süvendamiseks ja rekonstrueerimiseks Lääne-Eesti saarestikus. Keskkonnamõju hindamise aruanne.
- Ramboll Eesti AS, 2014. Balticconnector projekt KMH programm.
- Rattiste K., 2006. Life history of the Common Gull (Larus canus). A long-term individual-based study. Doktoritöö, Uppsala Ülikool.
- Raudsepp, U., Laanemets, J., Maljutenko, I., Hongisto, M., Jalkanen, J-P., 2013. Impact of ship-borne nitrogen deposition on the Gulf of Finland ecosystem: an evaluation. doi:10.5697/oc.55-4.837.
- Regional action plan on marine litter, 2015.
- Riigi jäätmekava 2014–2020, 2014.
- Riiklik arengukava „Eesti merenduspoliitika 2012–2020", 2011.
- Rolke, M., Michalek, M., Werner, M., Lehtiniemi, M., Strake, S., Antsulevich, A. & Zaiko, A., 2013. Trends in arrival of new non-indigenous species. HELCOM Core Indicator Report. Online. [24.09.15], (http://www.helcom.fi/Core%20Indicators/HELCOM-CoreIndicator-Trends_in_arrival_of_new_non-indigenous_species.pdf).
- Rünk, N., 2009. Keskkonnaparameetrite ajalis-ruumiline muutlikkus laia estuaari pinnakihis kevadperioodil (FerryBox andmete põhjal Soome lahes), Tallinna Tehnikaülikool, TTÜ Meresüsteemide Instituut, Okeanograafia õppetool.
- SA SEI Tallinn, 2011. Rahvusvahelise merendusorganisatsiooni (IMO) laevade ballastvee ja -setete alase kontrolli ja korralduse rahvusvahelise konventsiooni rakendamiseks vajalikud tegevused ja sotsiaal-majanduslikud mõjud.
- SA SEI Tallinn, 2012. Eesti mereala keskkonnaseisundi esialgse hindamise sotsiaal-majanduslik analüüs.
- SA SEI Tallinn, TÜ Eesti Mereinstituut, TTÜ Meresüsteemide Instituut, 2015. Eesti merestrateegia meetmekava. Eelnõu ettepanek.
- Saare maakonnaplaneeringu tuuleenergeetika teemaplaneering, 2013.
- Saat, T., R. Eschbaum, T. Raid, T. Drevs, and M. Kesler., 2011. Kalavarude seisund ja prognoos. Rahvusliku kalanduse andmekogumisprogrammi täitmine. I vahearuanne. pp. 1-30. Tallinn: TÜ Eesti Mereinstituut.
- Schlitzer, R., Ocean Data View, http://odv.awi.de, 2015.
- Seifert, T., Tauber, F., and Kayser, B., 2001. A high resolution spherical grid topography of the Baltic Sea – 2nd edition, Baltic Sea Science Congress, Stockholm 25–29 November 2001, Poster #147, http:/www.io-warnemuende.de/iowtopo.
- Sirp, S. and K. Klaas., 2011. Annual report on the implementation of Council Regulation (EC)No 812/2004. University of Tartu Estonian Marine Institute; The Ministry of the Environment.
- Skov H., Heinänen S., Žydelis R., Bellebaum J., Bzoma S., Dagys M., Durinck J., Garthe S., Grishanov G., Hario M., Kieckbusch J.J., Kube J., Kuresoo A., Larsson K., Luigujoe L., Meissner W., Nehls H. W., Nilsson L., Petersen I.K., Roos M. M., Pihl S., Sonntag N., Stock A. & Stipniece A., 2011. Waterbird Populations and Pressures in the Baltic Sea. Nordic Council of Ministers, Copenhagen. 203 p.
- Smith, M.E., Kane, A.S. & Popper, A.N., 2004. Noise-induced stress response and hearing loss in goldfish (*Carassius auratus*). The Journal of Experimental Biology 207, 427-435.
- Snoeijs P., 1999. Marine and brackish waters. Raamatus: Rydin H., Snoeijs P., Diekmann M. (toim.) Swedish Plant Geography, lk. 187–212.

- Sørmo E.G., Jüssi I., Jüssi M., Braathen M., Skaare J.U & Jenssen B. M., 2005. Thyroid hormone status in gray seal (Halichoerus grypus) pups from the baltic sea and the atlantic ocean in relation to organochlorine pollutants. Environmental Toxicology and Chemistry, 24 (3): 610–616.
- Sørmo E.G., Skaare J.U., Jüssi I., Jüssi M. & Jenssen, B. M., 2003. Polychlorinated biphenyls and organochlorine pesticides in baltic and atlantic gray seal (Halichoerus grypus) pups. Environmental Toxicology and Chemistry. Volume 22, Issue 11, Pages: 2789–2799.
- Statistikaamet. stat.ee, 31.08.2015.
- Suursaar, Ü., Kullas, T., 2009. Meretase ja hoovused Eesti rannikumeres muutuva kliima tingimustes. Rmt Kont, A. (toim.). Kliimamuutuse mõju Eesti rannikule – ASTRA projekti uurimistulemusi. Tallinna Ülikooli Ökoloogia Instituudi Publikatsioonid 11/2009, 25–43.
- Suursaar, Ü., Kullas, T., Otsmann, M., Saaremäe, I., Kuik, J. ja Merilain, M., 2006. Cyclone Gudrun in January 2005 and modelling its hydrodynamic consequences in the Estonian coastal waters. Boreal Environment Research, 11(2), 143 - 159.
- Žydelis, R., Bellebaum, J., Österblom, H., Vetemaa, M., Schirmeister, B., Stipniece, A., Dagys, M., van Eerden, M. & Garthe, S. 2009. Bycatch in gillnet fisheries - An overlooked threat to waterbird populations. Biological Conservation 142: 1269-1281.
- Thomsen, F., Lüdemann, K., Kafemann, R. & Piper, W., 2006. Effects of offshore wind farm noise on marine mammals and fish, biota, Hamburg, Germany on behalf of COWRIE Ltd.
- Tougaard, J., Carstensen, J., Teilmann, J., Skov, H. & Rasmussen, P., 2009. Pile driving zone of responsiveness extends beyond 20 km for harbor porpoises (Phocoena phocoena (L.). J. Acoust. Soc. Am., 126, 11–14.
- Tougaard, J., Henriksen, O.D., Miller, L.A. 2009b. Underwater noise from three types of offshore wind turbines: estimation of impact zones for harbor porpoises and harbor seals. J. Acoust. Soc. Am. 125, 3766–3773. HELCOM 2013.
- Transpordi arengukava 2014–2020, 2014.
- TTÜ Eesti Mereakadeemia, 2015. Veeldatud maagaasi laevakütusena kasutuselevõtu tehnilise ja majandusliku teostatavuse uuring.
- Tuomi, L., Kahma, K. K. and Pettersson, H., 2011. Wave hindcast statistics in the seasonally ice-covered Baltic Sea. Boreal Env. Res. 16: 451-472.
- TÜ Eesti Mereinstituudi koduleht http://www.sea.ee/valisosalusega-projektid/nema/ (19.09.15).
- TÜ Eesti Mereinstituut ja TTÜ Meresüsteemide Instituut, 2015. Avamere seire 2014.
- TÜ Eesti Mereinstituut, 2009. Väikese väina seisundi parandmise võimaluste uuring.
- TÜ Eesti Mereinstituut, 2011. Kassari lahe tööndusliku punavetikavaru uuringud. LEPING nr. 4-1.1/68, Tallinn.
- TÜ Eesti Mereinstituut, 2011b. Muuga sadama merekeskkonna seire. Vasutav täitja R. Aps.
- TÜ Eesti Mereinstituut, 2012. Eesti mereala keskkonnaseisundi esialgne hindamine. Aruanne EL-i merestrateegia raamdirektiivi artikkel 8-st tulenevate riiklike kohustuste täitmiseks.
- TÜ Eesti Mereinstituut, 2012b. Eesti Mereala Hea Keskkonnaseisundi indikaatorid ja keskkonnasihtide kogum. Aruanne MSFD artikkel 9 ja 10 nõuete täitmiseks.
- TÜ Eesti Mereinstituut, 2015. Ohtlikute ainete seire meres. Riikliku keskkonnaseire programmi mereseire allprogramm. 2014. aasta aruanne.

- Uiboupin R. and Laanemets J., 2009. Upwelling characteristics derived from satellite sea surface temperature data in the Gulf of Finland, Baltic Sea. Boreal Env. Res. 14: 297-304.
- Vabariigi Valitsuse 25. juuli 2000. a määruse nr 247 *Tervisekaitsenõuded supelrannale ja suplusveele* (RT I 2000, 64, 407).
- Vabariigi Valitsuse 3. aprilli 2008. a määrus nr 74 Nõuded suplusveele ja supelrannale (RT I, 29.08.2011, 6).
- Vabø, R., Olsen, K. & Huse, I., 2002. The effect of vessel avoidance of wintering Norwegian spring-spawning herring. Fisheries Research 58, 59–77.
- Verevkin, M.V., Vysotsky, V.G., Lisitsyn, A.V., 2011. Catastrophic decreasing of population size of the Baltic ringed seal (Pusa hispida botnica) in the Gulf of Finland (East part of the Baltic Sea) 19th Biennial Conferenceon the Biology of Marine Mammals \ avaldamisel.
- Weston, D. P., 1990. Quantitative examination of macrobenthic community changes along anorganic enrichment gradient. Marine Ecology Progress Series, 61, 233–244.
- Vetemaa, M. & Piirisalu, U., 2011. "Hülgekahjude vähendamine püügivahendite hülgekindlamaks ehitamise ja hülgepeletite kasutusele võtmise abil. PRIA projekti aruanne." Tartu: TÜ Eesti Mereinstituut.
- Vetemaa, M., Eschbaum, R., Albert, A., Saks, L., Verliin, A., Jürgens, K., Kesler, M., Hubel, K., Hannesson, R., Saat, T., 2010. Changes in fish stocks in an Estonian estuary: overfishing by cormorants? ICES Journal of Marine Science 67(9): 1972-1979.
- WWF Baltic Ecoregion Programme, 2010. Future Trends in the Baltic Sea, 40 pp.
- Wysocki, L.E., Dittami, J.P. & Ladich, F., 2006. Ship noise and cortisol secretion in European freshwater fishes. Biological Conservation 128, 501–508;
- Üleriigiline planeering *Eesti 2030*+, 2012.